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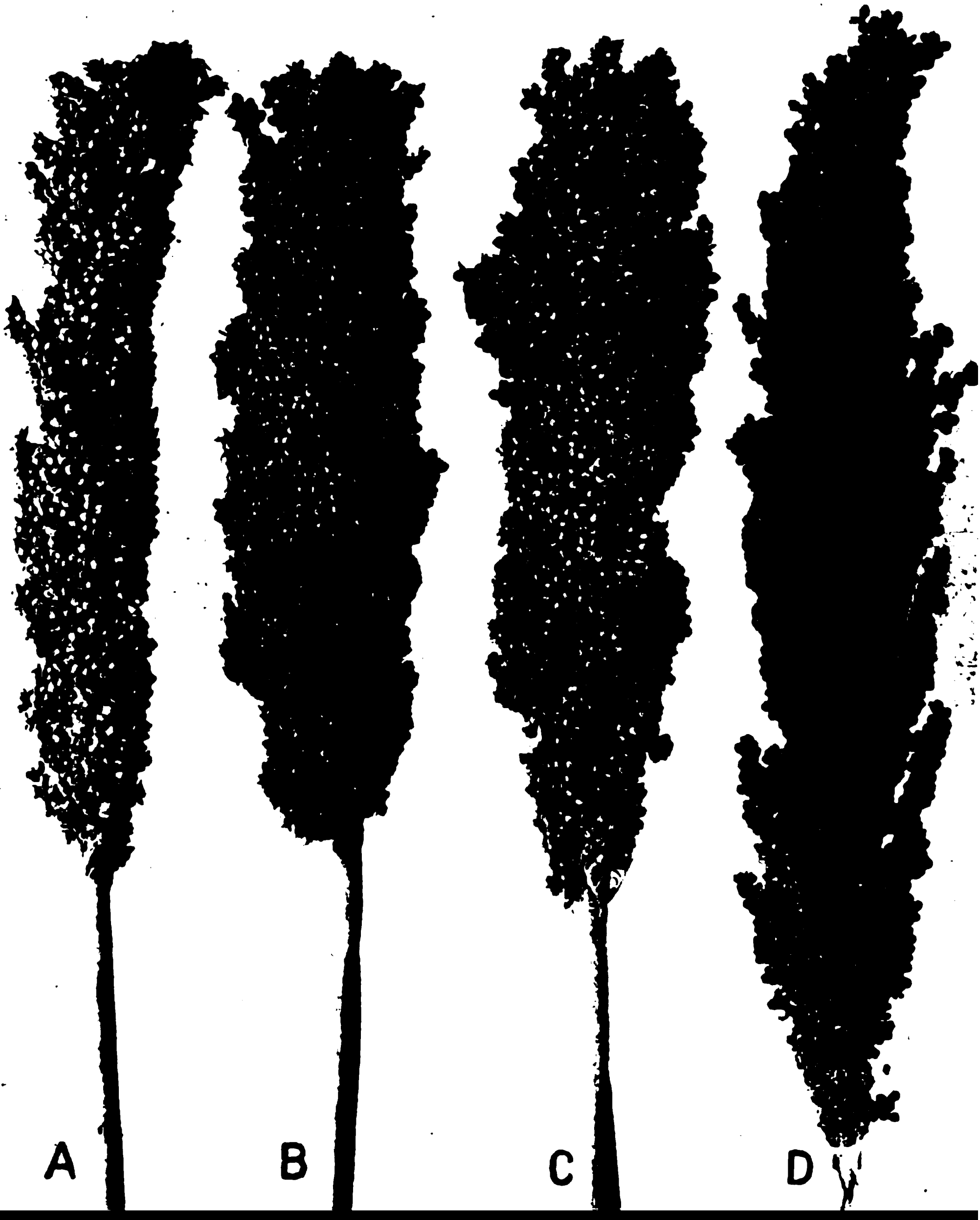

Farmers' bulletin

United States. Dept. of Agriculture

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U. S. DEPARTMENT OF AGRICULTURE,

DIVISION OF PUBLICATIONS.

FARMERS' BULLETINS

Nos. 551–575,

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WITH CONTENTS AND INDEX.

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U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 551.

THE CULTIVATION OF AMERICAN GINSENG.

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BY

WALTER VAN FLEET,
Physiologist, Drug-Plant, Poisonous-Plant, Physiological, and Fermentation Investigations.

WASHINGTON:
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1913.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., May 29, 1913.

Sir: I have the honor to transmit herewith a paper entitled "The Cultivation of American Ginseng," by Dr. Walter Van Fleet, which has been submitted by Dr. R. H. True, Physiologist in Charge of Drug-Plant, Poisonous-Plant, Physiological, and Fermentation Investigations, and to recommend that it be published as a Farmers' Bulletin.

Respectfully,

Wm. A. Taylor,
Chief of Bureau.

Hon. D. F. Houston,
Secretary of Agriculture.

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THE CULTIVATION OF AMERICAN GINSENG.

INTRODUCTION.

American ginseng is a fleshy-rooted herbaceous plant growing naturally on the slopes of ravines and in other shady but well-drained situations in hardwood forests in varying abundance from Maine to Minnesota and southward to the mountains of Georgia and the Carolinas. It has long been valued by the Chinese for medicinal use, though rarely credited with curative virtues by the natives of other countries. The dried roots have been exported from this country in increasing quantities since the early years of the eighteenth century, the prices rising as the wild supply diminished because of the clearing away of suitable forests from about 40 cents a pound in the early years of its collection to more than $6 a pound for the best qualities during the last eight years.

The cultivation of native ginseng, stimulated by its increasing scarcity and the rising prices, began in an experimental way about 15 years ago and has attained such proportions that the output of cultivated roots is little short of that collected from the forests and in the present state of the market has nearly the same value. It is reasonable to assume that the cultivated root must eventually displace the wild article as a commodity for export, but any rapid increase of production at this juncture might depress selling prices, which are not thought to exceed greatly the cost of growing and marketing, when the slow development of the plants and the relatively expensive equipment needed for ginseng culture are duly considered.

A negligible quantity of ginseng root is consumed by Chinese residents of North America, and a trifle has been used by manufacturers of domestic medicine, leaving practically the sole outlet for this product with the Koreans and Asiatic Chinese. The exports and valuation of American ginseng for the nine years ended June 30, 1912, are as follows:

TABLE I.—*Exports and value of ginseng from 1904 to 1912, inclusive.*

Year.	Pounds.	Total value.	Average value per pound.
1904	132,882	$851,820	$6.41
1905	146,576	1,069,849	7.56
1906	160,949	1,175,844	7.30
1907	117,696	813,023	6.80
1908	154,180	1,111,994	7.21
1909	186,257	1,270,632	6.82
1910	192,406	1,439,434	7.48
1911	153,999	1,088,202	7.06
1912	155,308	1,199,301	7.20

As yields of dry root from well-managed plantings appear to be at the rate of a ton to the acre, it will be realized that the product of 100 acres of mature root could very readily supply our present average exportation of 164,530 pounds. This would represent total plantings of nearly 700 acres, as it requires at least six years to grow marketable roots from seeds. Taking into consideration the growing interest in ginseng culture, the increasing output, and the probability that wild roots may continue to furnish a supply for some years, it appears best to regard the future of the industry with conservatism.

THE GINSENG PLANT.

American ginseng (fig. 1) is botanically known as *Panax quinquefolium*, of the family of Araliaceæ. In its wild state it grows from 8 to 20 inches high, bearing three or more compound leaves, each consisting of five thin, stalked, ovate leaflets, pointed at the apex and rounded or narrowed at the base, the three upper leaflets being larger than the two lower ones. A cluster of from 6 to 20 small greenish yellow flowers is produced in midsummer, followed later by as many bright-crimson berries, each containing from one to three flattish wrinkled seeds the size of small peas.

The root is thick, spindle shaped, 2 to 4 inches long, and one-half to 1 inch or more in thickness, generally branched in the older specimens and prominently marked with circular wrinkles. Branched roots having some resemblance to the human form are said to be in particularly high favor in China.

The seeds (fig. 2) are slow in germination and should never be permitted to dry out. They are usually stratified in moist sand, old sawdust, or woods earth and stored in a damp, cool place until cracked by incipient germination, which may be considerably delayed and usually does not occur until the year following their ripening. The subsequent development of the plant is also relatively slow, as it requires from five to seven years to grow marketable roots from seeds or young roots. Under favorable circumstances the plants begin to fruit about the third year and when over 5 years old may produce as many as 50 seeds annually.

The older roots possess the most substance and when properly cured realize the highest prices. It appears almost useless to offer for sale 3-year or 4-year roots, even if well grown and of good size, as buyers for the Chinese market have learned to discriminate against them.

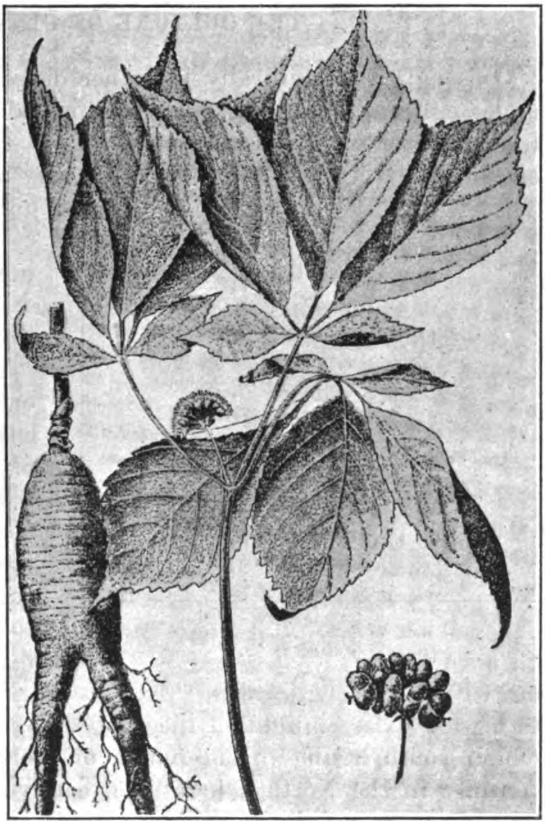

FIG. 1.—Branch, root, and berries of American ginseng. (Reproduced from Bulletin 16, Division of Botany.)

STARTING THE PLANTATION.

In planting ginseng beds it has been found desirable to start with both young roots and seeds. By securing roots three or more years old a moderate seed crop may be had the first season. A stock of 1-year or 2-year roots set at the same time will start the rotation, and it is well to plant seeds also if germinated ones are available.

Seeds and roots of various ages for stock are freely offered by dealers advertising in current horticultural periodicals. Seeds are now procurable at prices varying from $1 to $2.50 per thousand, and roots from 50 cents to $3 per hundred, according to age and source. Stratified seeds cost about 50 per cent more than fresh seeds, but may be regarded as far more useful for beginners. There are about 8,000 seeds in a pound. As the output of seeds is likely in time to exceed the capacity of the plantation, it is well to restrict the production by nipping the flower heads, unless a good market for the seeds is assured. Roots gain more rapidly in size and weight if the plants are not permitted to seed.

While small dooryard and woodland plantings may be grown with little outlay, ginseng culture on a large scale is quite expensive. The cost of equipping and starting ginseng beds on a commercial basis does not appear under present conditions to fall far short of $1,500 per acre, exclusive of the value of the land.

THE CULTURE OF GINSENG.

Ginseng grows naturally in rather dense shade and when placed under cultural conditions must be shielded from direct sunlight by tree shade or some construction that will reduce the light to about one-fourth its normal intensity. This may be accomplished by planting it in forest beds, or, in cultivated ground, by erecting sheds open to the north and possibly to the east, but covered at the top and the south and west with laths or boards so spaced as to cut out nearly three-fourths of the sunlight. Brush and heavy burlap have been used with fair success for shading, but thin or ordinary muslins are useless, as they do not intercept enough light. Denser shade is required in southern localities than in the North. The rule appears to be one-sixth sunlight in the latitude of Kentucky and somewhat denser south, rising to one-fourth or more in Michigan and Wisconsin. In the North, where open construction is preferred, Lima beans or morning-glories may be planted on the south and west sides and allowed to run on poultry netting, thus furnishing shade during the brightest summer months.

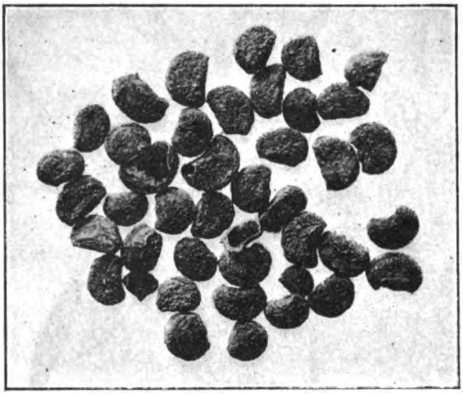

FIG. 2.—Seeds of American ginseng. (Natural size.)

There are many methods of construction, but the most common is to set posts firmly in the ground 8 feet apart each way and about 7 feet high above the ground. Scantlings 2 by 4 inches in size are nailed on top of the posts, running the long way of the shed. The shade is usually made in sections 4 by 8 feet long, using common 4-foot laths or slats nailed on strips 2 by 2 inches and 8 feet long. The laths should be spaced from one-fourth to one-half inch apart, according to locality, whether in the North or in the South. These sections of shading are laid on top of the 2 by 4-inch runners and so nailed to the posts that the laths run about north and south, thus giving the plants below the benefit of constantly alternating light and shade. (Fig. 3.)

For covering seed beds a rather low shade is desirable, in order to prevent the washing out of the seeds by the drip from the laths. Poultry netting covered with brush, straw litter, or burlap, made light in spring and denser as the sun gains power, answers very well.

The beds under shade should be 4 feet wide and preferably should run east and west, being so placed that the drip will fall to a great extent in the paths. The sides may be of 12-inch boards set 8 inches or more in the ground to keep out moles and held in place with small stakes. The soil should be fairly light and so well drained naturally or artificially that water can at no time remain on the beds. It should be in a condition to grow good vegetables without the addition of strong manure.

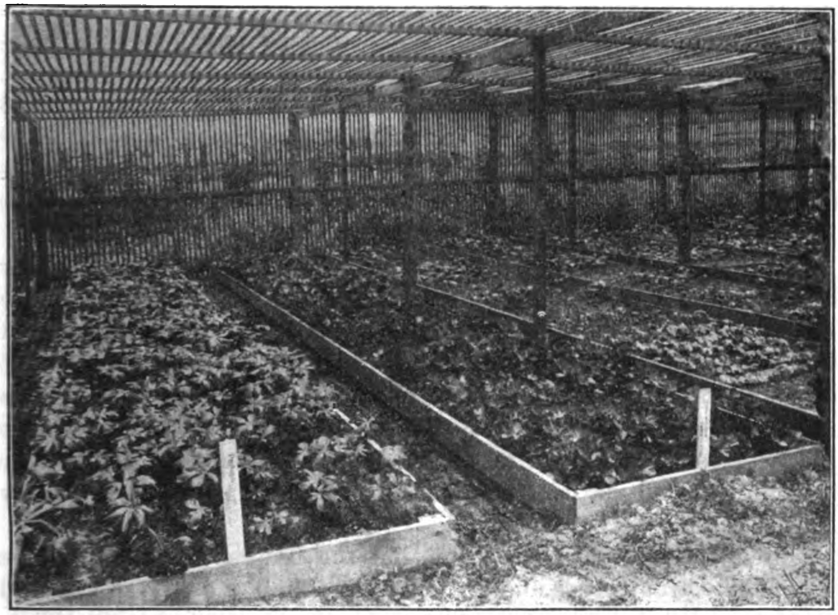

FIG. 3.—Lath shed affording partial shade, especially well suited for growing ginseng and other woodland plants.

The very best fertilizers are woods soil or rotted leaves 4 to 6 inches deep, well incorporated to a foot in depth, and fine raw bone meal well worked in, applied at the rate of 1 pound to each square yard. If yard manures are used they should be very thoroughly rotted and in order to give the best results should be worked in some months previous to planting the beds. Chemical fertilizers and wood ashes have been used, but as seriously injurious results have sometimes followed it is best, for the beginner at least, to depend on rotted leaves and raw ground bone to enrich the soil. For seed beds the soil should be half woods earth, free from fiber, and if inclined to be heavy, enough sand should be added so that the mixture will not bake or harden even after heavy rains.

PLANTING THE BEDS.

Ginseng seeds are best planted in spring as early as the soil can be worked to advantage. Only cracked or partially germinated seeds should be used. They may be planted 6 inches apart each way in the permanent beds or 2 by 6 inches in seed beds and transplanted to stand 6 or 8 inches apart when 2 years old. The seeds should be covered 1 inch deep with woods soil or old rotten hickory or basswood sawdust. That from pine or oak trees should not be used. The roots may be set any time from October to April when the soil is in suitable condition, the crowns being placed about 2 inches below the surface. The most approved distances to plant are 6 or 8 inches apart each way, the latter being preferred when 7-year-old roots are to be grown.

Many planters round the surface of the beds, making the center several inches higher than the sides, since they find space for more plants on the curved than on the flat surface; but others claim that the possible injury from drought in very convex beds more than offsets this advantage. It is important, however, to have the centers high enough not to retain water after a rain. For roots the beds should be worked fully 12 inches deep, but the seed beds need not be so deeply stirred, as it is not advisable to have them settle to any marked extent.

Ginseng needs little cultivation, but the beds should at all times be kept free from weeds and grass, and the surface of the soil should be scratched with a light tool whenever it shows signs of caking. Ginseng seedlings grow about 2 inches high the first year, with three leaflets at the apex of the stem. The second-year plants may reach 5 or 6 inches in height, bearing two compound leaves each composed of five characteristic leaflets. A third leaf is generally added the next year and fruits may be expected. In succeeding years a fourth leaf is formed and the fruiting head reaches its maximum development, sometimes producing as many as 100 seeds, but the average under cultivation seldom exceeds 40 seeds to a plant.

MULCHING.

In accordance with natural conditions a winter mulch over the crowns is essential, especially in northern localities. Forest leaves held in place with poultry netting or light brush are best, but cornstalks stripped of the husks, bean vines, cowpea hay, or other coarse litter not containing weed seeds or material attractive to mice will answer the purpose. It should not be placed in position until actual freezing weather is imminent and should be removed in spring before the first shoots come through the soil.

A mulch of 4 or 5 inches of leaves or their equivalent in litter is ample for the severest climate, and less is needed in the South. Seedling beds particularly require careful mulching to prevent heaving by frost.

VENTILATION.

Free ventilation is very necessary for ginseng. In the forest, owing to the height of the protective canopy of trees, air currents are almost constant. This condition should be borne in mind in the construction of artificial shade, and the shed should contain as few obstacles as possible to the free circulation of air. Open sides at the north and east will generally insure free ventilation.

PROTECTION.

Owing to the comparatively high cost of ginseng plants and roots, the beds should be well protected by secure fences from the intrusion of wild or domestic animals and should also be securely guarded against theft, which is not uncommon with this high-priced product. Protection is especially needed with forest plantings, which should always be well inclosed. Moles may be controlled with suitable traps, of which there are several kinds on the market, or the beds may be guarded with boards or wire netting of sufficiently close mesh set 12 to 18 inches in the ground.

GINSENG VARIETIES.

The culture of native ginseng has been too brief to induce varietal changes, but liberal fertilization and continual selection of seeds from individual plants having superior commercial characteristics will doubtless in the end favorably modify the wild type of plants. There are, however, various recognizable geographical races, not all of the same value to the grower. Plants from the northern range, particularly those indigenous to New York and Wisconsin, appear to possess the most useful characteristics and form the best basis for breeding stocks. Southern ginseng, though vigorous and forming roots of good size and shape, does not seed well in northern localities, evidently finding the season too brief. Some of the western types have long, thin roots of undesirable character, and another local form, dwarf in growth, has small, round, and almost worthless roots. The beginner should endeavor to procure from reliable dealers the best commercial types of ginseng as a foundation for his breeding stock.

DISEASES OF GINSENG.

The diseases of cultivated ginseng appear to be chiefly incident to the crowding of the plants, deficient drainage, and lack of ventilation. In their natural state the plants as a rule are thinly scattered on the forest floor under advantageous conditions of ventilation and soil drainage, the normal action of tree roots playing no inconsiderable part in the latter condition, and diseases, of which there are several, are likely to remain quite local in effect; but under the crowded conditions of commercial culture they tend to spread and may cause material injury. Errors in fertilization and soil treatment are also fruitful sources of injury and by weakening the resistance of the plants further invite the inroads of disease. Bulletin No. 250 of the Bureau of Plant Industry treats of ginseng diseases and their control in the light of the most recent researches. Prospective growers will find it of advantage to consult this work.

FOREST PLANTINGS.

The earlier successes with ginseng culture were made with forest plantings, and this method is still preferred by many growers where the proper conditions are available. The shade should be fairly dense, but should be produced by tall, open-headed trees rather than by undergrowth. Good drainage is essential, as the plants will not thrive in wet soils. The soil should be deeply plowed or spaded, all tree roots removed, and their further encroachment should be prevented by cutting around the beds yearly with a sharp spade. Leaf mold or well-decayed litter should be liberally worked into the soil, and an application of bone meal raked into the surface will in most cases prove a useful addition. The culture of forest beds is in all respects similar to that under artificial shade, and the winter mulch should in no case be omitted.

DIGGING THE ROOT.

The cured root is valued by the Chinese largely according to its size and maturity. The best qualities of proper age break with a somewhat soft and waxy fracture. Young and undersized roots dry hard and glassy and are regarded as less desirable. Very small roots and root fibers often realize less than a dollar a pound, while those of the proper size and quality sell readily at top quotations. Cultivated roots as a rule attain greater size than wild ones of the same age, but lack density of substance until well past the fifth year of development.

Beds should rarely be dug for market until the sixth year, and should then be taken up solidly and the undersized roots replanted or securely heeled in until time to plant in the spring. Good roots should run nearly 4 inches long, half an inch in thickness below the crown, and average about an ounce in weight in the fresh state.

Roots may be dug at any time after growth ceases in September, but mid-October is regarded as the most favorable time. They should be carefully washed or shaken free of all adhering soil, but not scraped, as it is important to preserve the natural dusky color of the skin with its characteristic annular markings.

Curing is best effected in an airy room heated to about 80° F. by a stove or furnace. The roots are spread on lattice trays and are frequently examined and turned, but must always be handled gently to avoid breaking the forks or marring the surface. It requires nearly a month of drying to cure the larger roots properly, but the heat may well be diminished toward the end of the process except in noticeably damp weather. In all stages of curing particular care should be taken to see that the root does not mold or sour, as any defect will greatly depress the selling price. On the other hand, overheating should be avoided, as it tends to discolor the surface and spoil the texture of the interior. Once well cured, the roots should be stored in a dry and airy place, secure from vermin, until ready for sale. The market lies with the wholesale drug dealers, some of whom make a specialty of buying ginseng root for export.

CONCLUSION.

Ginseng is a native product of recognized importance. The export trade in dry roots has existed for more than a century and has attained an average value of over a million dollars annually for the past decade.

The natural production, diminished by overcollection and the contraction of suitable forest areas, has dwindled to such an extent that prices have risen to levels warranting cultivation, which has proved quite successful in judicious hands. The plant, however, has little domestic value except for the exploitation of amateur cultivators and depends on a distant oriental market for its standing as a commodity. As a commercial product it would appear particularly liable to overproduction, which danger, however, is greatly lessened by the slow development of the plant and the inherent difficulties of its cultivation.

Under the present conditions of production ginseng offers attractive possibilities to patient cultivators who are in sympathy with the limitations of growth and the slow development of woodland plants in general and who are willing to make a material outlay with only scanty returns in view for several years to come, but it holds out little inducement for inexperienced growers looking for quick profits from a small investment.

The culture of ginseng and of special crops generally is best begun in an inexpensive and experimental manner, enlarging the equipment only as reasonable success seems assured. "Plunging" in ginseng is as likely to prove disastrous as in other forms of business enterprise.

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U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 552.

KAFIR AS A GRAIN CROP.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., June 24, 1913.

Sir: I have the honor to transmit and to recommend for publication as a Farmers' Bulletin the accompanying manuscript entitled "Kafir as a Grain Crop," prepared by Messrs. Carleton R. Ball, Agronomist and Acting Cerealist in Charge, and Benton E. Rothgeb, Scientific Assistant, Office of Cereal Investigations.

The rapid increase of settlement in the dry-land areas, where kafir and other grain sorghums are important, and the widespread promotion of kafir growing by various agencies have resulted in the greatly increased demand for information regarding kafir varieties and methods of growing them. It is estimated that more than a million acres of corn in western Oklahoma were replaced by kafir in the single season of 1912 and that the expansion of kafir growing in that State will be fully as great in 1913. A similar though less pronounced movement is taking place in western Kansas and western Texas.

Respectfully,

Wm. A. Taylor,
Chief of Bureau.

Hon. D. F. Houston,
Secretary of Agriculture.

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KAFIR AS A GRAIN CROP.

INTRODUCTION.

Kafir varieties were introduced into the United States from southeastern Africa in 1876. They were first introduced into the Great Plains area about 25 years ago, when the rapid settlement of the dry lands created a demand for drought-resistant crops, and have since held first place among the sorghums grown.

DESCRIPTION AND ADAPTATION.

The kafirs may be separated from the other sorghums by their stout, stocky, short-jointed stems (see fig. 3); their broad, stiff leaves, 12 to 16 or 18 in number, set very close together, especially on the lower half of the stem; and their erect, cylindrical or oblong, and heavy heads (fig. 1) of medium-sized oval seeds which are about half covered by the short glumes or hulls. In juiciness the stalks are intermediate between the sorgos, which are very full of sweet juice, on the one hand, and the milos, durra, and kaoliangs, in which the pith is rather dry, on the other.

The kafirs are grown for grain production from the Gulf of Mexico north to southern Nebraska and west to eastern Colorado in the Great Plains area. Only the very earliest can be grown successfully at these northern and western limits. They are grown also in California, but not in the Great Basin nor in the Pacific Northwest.

Like all sorghums, the kafirs are sensitive to the effects of cold and must not be planted until the soil is well warmed in the spring. This is usually about 15 days later than the date for planting corn. Even then the early growth is very slow.

VARIETIES.

There are now five fairly well marked varieties of kafir under cultivation in the United States. These are White kafir, Blackhull kafir, Dwarf Blackhull kafir, Pink kafir, and Red kafir. More Blackhull kafir is grown than of all the others combined. The Dwarf Blackhull is a newly developed form which probably will soon supplant the standard Blackhull throughout much of its present range. Many other forms and varieties have been introduced and tested, but none has yet been found of certain value.

These varieties may be readily distinguished by the following simple key:

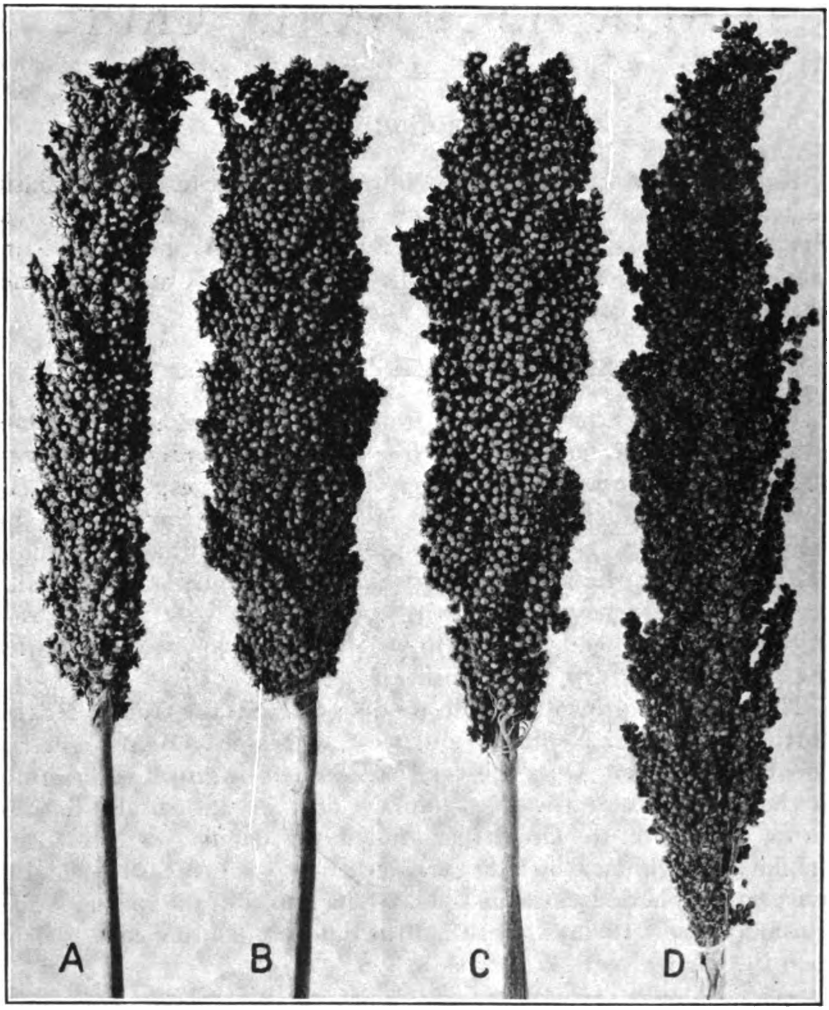

FIG. 1.—Heads of four varieties of kafir: *A*, White kafir; *B*, Guinea kafir (Guinea corn of the West Indies); *C*, Blackhull kafir; *D*, Red kafir. (About one-third natural size).

Seeds white, glumes white	White kafir.
Seeds white, glumes black, stalks 5 to 8 feet tall	Blackhull kafir.
Seeds white, glumes black, stalks 3 to 4½ feet tall	Dwarf Blackhull kafir.
Seeds pink, glumes white	Pink kafir.
Seeds red, glumes black	Red kafir.

A brief description of each variety, with a discussion of its adaptation, is given herewith.

White Kafir.

White kafir, one of the original introductions, was once extensively grown, but has been largely displaced by the Blackhull kafir. It is rather dwarf, usually only 3½ to 5 feet high in the dry-land areas, and is quite early, the earliest, in fact, of all varieties. The leaves are fewer and smaller and the heads are more slender than those of Blackhull kafir. The seeds and the hulls are white. Properly called White kafir, the name "White-hulled White" is occasionally applied to it.

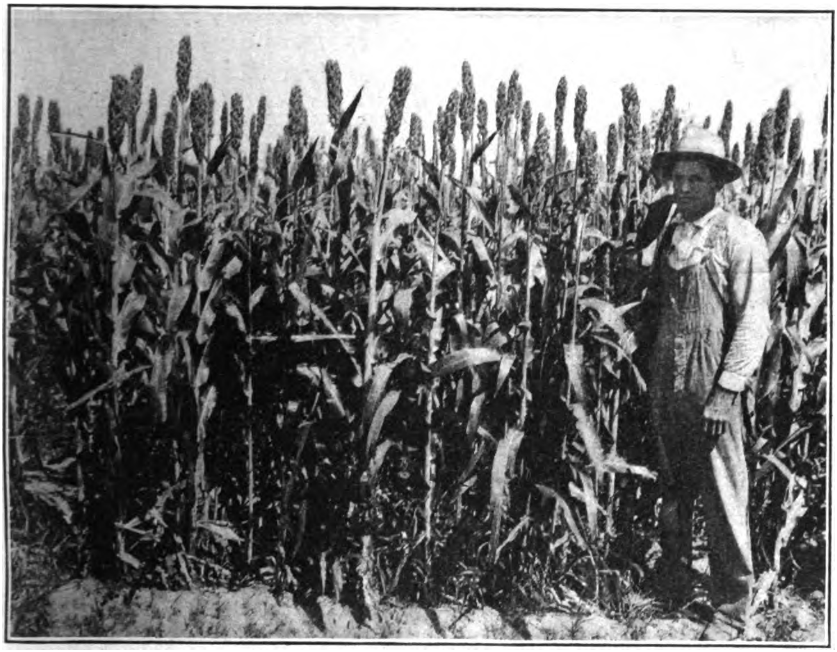

FIG. 2.—A field of Blackhull kafir at the Kansas State substation, Dodge City, Kans., September 1, 1911.

Its chief value lies in its early maturity, but the heads frequently remain partly inclosed in the boot or upper leaf-sheath, especially in unfavorable seasons. It is not recommended for general cultivation.

Blackhull Kafir.

Blackhull kafir is the most widely grown of all the kafir varieties (fig. 2), owing to its satisfactory habits and high grain yields. The stalks are stout and usually grow to a height of 5 to 6 feet in the dry-land area, and 6 to 8 feet elsewhere. The leaves are 12 to 16 or 18 in number, 2 to 3 feet long, and 3 to 5 inches wide. The heads are stout, rather compact, 10 to 14 inches long, with black hulls and white seeds. The heads are normally completely exserted from the boot.

This variety requires from 115 to 140 days to mature, depending on the locality and seasonal conditions. It is not as early as either the White kafir or the Dwarf Blackhull form (figs. 3 and 4) and therefore can not be ripened successfully at as high elevations or in as northern localities. It does well as far north as the north line of eastern Kansas, but in general is not as well adapted to the high plains of northwestern Texas, eastern Colorado, and northwestern Kansas as are the earlier varieties mentioned.

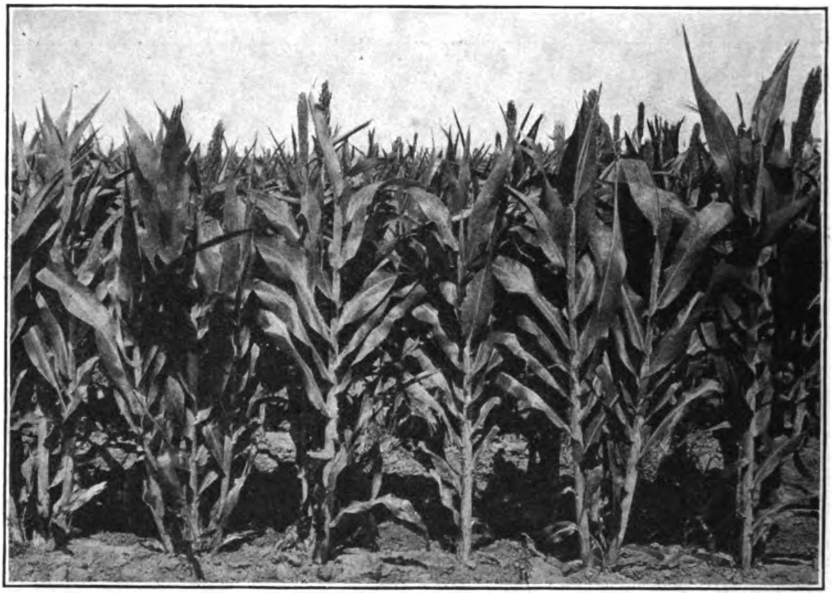

FIG. 3.—A plat of Blackhull kafir (C. I. No. 71) on the experiment farm at Dalhart, Tex., August 31, 1911. Compare the stage of development with that of the Dwarf Blackhull kafir in figure 4, planted on the same day in an adjacent plat.

Blackhull kafir should not be confused with a somewhat similar but much later ripening plant of little value, sold under the names "African millet," "branching dhoura," etc.

Dwarf Blackhull Kafir.

Dwarf Blackhull kafir is a newly developed form of the Blackhull variety. It originated as a sport from an early-maturing selection of ordinary Blackhull kafir. It grows only 3 to 4½ feet in height under dry-land conditions and matures from five to ten days earlier than the standard Blackhull strains (figs. 3 and 4). It differs from the ordinary Blackhull kafir, both in dwarf stature and earliness. These are two very important factors, however, in the value of a reliable grain crop in a large part of the Great Plains area. Both earliness and dwarf stature permit the maturing of the crop of seed with the use of less water than would otherwise be necessary. Earliness also permits maturing under the conditions of short season which are found in the high plains, where the first fall frosts sometimes occur in the last days of August.

The culture of this variety is being rapidly extended into the higher portion of the central and southern Great Plains area, which was mentioned under Blackhull kafir. In this section it is increasing the production of the kafirs. It is probable that within a few years it will supplant the standard Blackhull varieties not only in these higher sections but in a portion of the lower areas where it is desired to use a header in harvesting the crop.

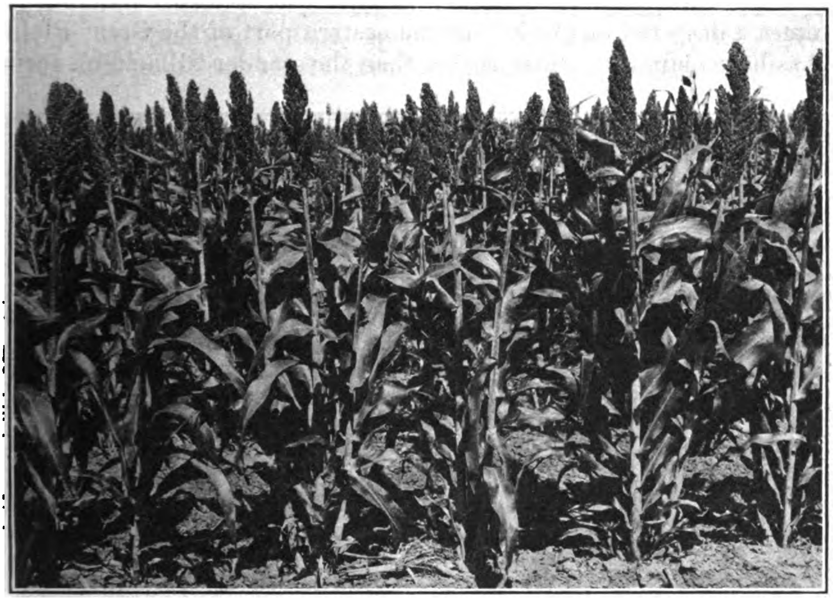

FIG. 4.—A plat of Dwarf Blackhull kafir (C. I. No. 340) on the experiment farm at Dalhart, Tex., August 31, 1911. Compare its earliness with that of standard Blackhull kafir (fig. 3) planted on the same day.

Pink Kafir.

Recent introductions of many kafir forms from South Africa have brought to light some with seeds of various shades of pink and light red, more or less intermediate between the white-seeded and red-seeded sorts. Two or three of the best of these have been introduced to cultivation as forage varieties under the name of "Pink kafir." None has yet shown special value as a grain producer.

Red Kafir.

Red kafir (fig. 5) is one of the original introductions and was once grown more extensively than at present. It has been largely replaced by the Blackhull kafir, partly because of its red seeds and partly because of the more elongated head. In habit of growth it is not very different from the Blackhull variety, although the leaves are slightly narrower and perhaps a little darker in color than those of the Blackhull. The heads are long and cylindrical, sometimes reaching a length of 18 to 20 inches (fig. 1, D). The seeds are red and the glumes a deep red or black. In the eastern part of the Great Plains it has been claimed to ripen earlier than the standard Blackhull sorts. Under the drier conditions and higher elevations of the western portion of this area, however, it has almost always been later in maturing.

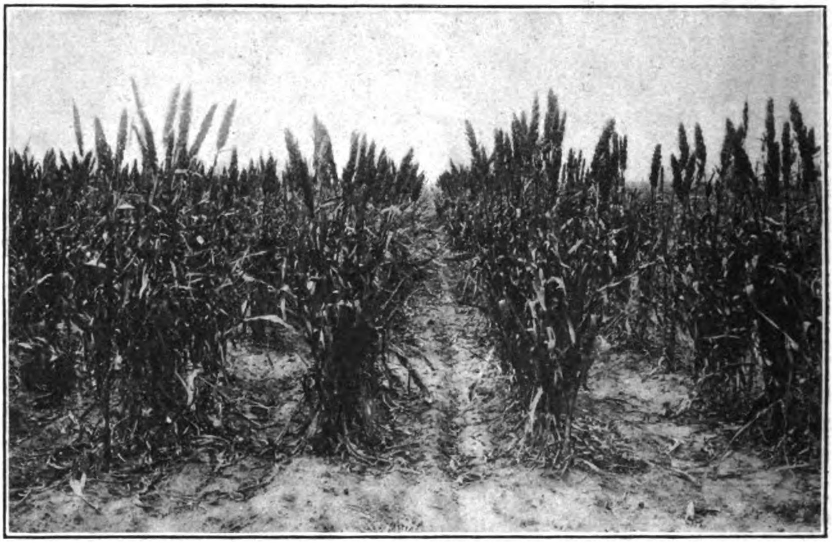

FIG. 5.—End view of a plat of Red kafir at the Cereal Field Station, Amarillo, Tex., September 10, 1907.

Owing to the length of the heads and the height of the stalk it is not so well adapted to harvesting with a grain header as are the shorter varieties. On the other hand, the red seeds are not so attractive to birds as white seeds, probably because of their higher tannin content, at least before ripening.

CULTURE OF THE CROP.

The different varieties are so similar in habit that they do not require different cultural treatment. Different treatment is required, however, in different sections and in different seasons, and on different soils in the same section.

PREPARATION OF THE SEED BED.

It is generally conceded that fall plowing is preferable to spring plowing. The quantity of precipitation during the winter determines the relative value of fall plowing and spring plowing. Fall plowing has the advantage if the precipitation during the winter is heavy, as it is better fitted to catch and absorb the moisture from either rain or melting snow.

Plowing should be deep, whether done in the fall or spring. The land should then be well worked in the spring with a harrow or disk before planting. Time spent in preparing a fine, even seed bed is well worth while. It not only aids germination and so insures a more uniform stand, but also germinates weed seeds and destroys large numbers of young weeds.

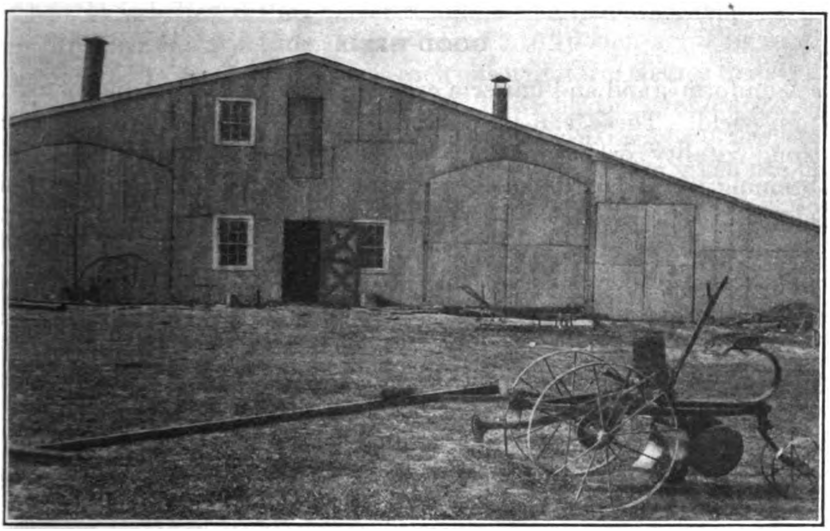

FIG. 6.—A lister planter for planting corn and grain sorghums in furrows at the Hays branch station Hays, Kans.

On all soils subject to blowing listing is preferable to plowing. Listing not only largely prevents the blowing of the soil, but also protects the young plants from being cut off by moving soil grains. The lister is essentially a plow with a double moldboard (fig. 6). It cuts a wide and deep furrow, turning the soil therefrom on the unbroken land on either side. Listing differs from plowing, therefore, in that the furrow just made is not filled at the next round, but the next furrow is made from 2½ to 3½ feet away from the first. The land is thus left in alternate furrows and unbroken ridges, the loose soil from the adjacent furrows being piled on top of the ridges.

The listing is done in the fall and the land lies over winter in this rough condition. Since the prevailing winds are from the southwest or the northwest, the listing is done east and west where possible. The winter snowfall is held to a large extent in the lister furrows, and is thus distributed fairly evenly over the entire field, instead of drifting into the fence rows or blowing entirely off the land. When the soil begins to drift under the influence of the spring winds of March and April the only effect is to move the soil from the ridges into the adjacent furrows. Preparing the land for planting in the spring is done in two ways: (1) By relisting, which is done by breaking the ridges with the lister and thus partially filling the adjacent furrows; or (2) by working down the lister ridges with the disk harrow. In the first case the crop will be planted with the lister planter in the new furrows opened, while in the second it will be surface-planted.

GOOD SEED.

A uniform stand and uniform crop are necessary to produce a maximum yield. These can be obtained only by planting pure seed of strong vitality or germinating power. The best farm method of obtaining pure seed of good vitality is by going through the field before the crop is harvested and gathering enough typical heads to furnish seed for the following season.

The kafirs cross readily with other sorghums, including sorgo, durra, milo, broom corn, etc., which are commonly grown in the kafir area. The prevailing winds in the Great Plains area are from the south, and pollen is carried a considerable distance to the north. For this reason no heads intended for seed purposes should be selected from a part of the kafir field which is within 15 or 20 rods of a field of any other sorghum crop. The common practice of getting seed for planting from the bin of bulk seed should be abandoned.

Selected heads should be strung on a cord or wire, hung to the rafters or wall of a granary or some dry shed, and left unthrashed until spring. Before the time for planting the seed should be tested for its germinating power. Well-selected and well-stored seed will show a germination of 99 to 100 per cent. The method of testing is simple, and the operation can be easily performed on any farm. Place 100 or 200 seeds between pieces of blotting paper or cloth, place these between plates, and keep moist. They should be set in a warm room and allowed to germinate from four to six days. The seed used in this test should always be an average sample of that which is to be planted.

PLANTING.

Time of Planting.

The time for planting kafir is from 10 days to 2 weeks later than the average date for planting corn in any given locality. Like most other sorghums, kafir is a subtropical plant, and the seed will not germinate readily in cold soil. The seed may rot before germination takes place, or the slow-growing young plants may be choked by weeds. The result will be a poor stand or, in extreme cases, no stand at all.

Rate of Planting.

The rate of planting will depend somewhat upon whether the crop is grown principally for the grain or as a combined grain and forage crop. When planted for grain production, the stand should be thinner than in the second case. Most corn planters are equipped with plates which drop three or four kernels of kafir in a hill at intervals of 12 to 18 or 20 inches in the row. This makes a comparatively thick stand if the seed is of good quality and the conditions are favorable. It is believed that better results are obtained where the seeds are dropped one at a time at intervals of 7 to 10 inches. This regular spacing of the single plants gives each one a uniform chance to develop. It also shades the ground more fully, lowering the evaporation and checking the growth of weeds. On the high plains of northwestern Texas one plant to each 8 or 9 inches of row space has given the best results for a series of years. A slightly thicker seeding will be possible at lower elevations and under less severe conditions.

In planting it must be kept in mind that droughts are of common occurrence in the kafir-growing area. The tendency is to plant the crop too thick, which results in a total failure of grain in dry seasons. A thin stand will produce an excellent yield of grain in a wet season, a good yield in a normal season, and a fair yield in a dry season. This is more profitable than a thick stand giving a very high yield in a wet season and no grain at all in a very dry season.

Special sorghum plates are provided with most types of corn planters. These plates are mostly made to drop the grains in hills. Better results may generally be had by buying blank plates and having them drilled with holes of the size and number desired. These holes should be slightly countersunk from the under side, so that the kernels will not become wedged in them. The chief difficulty is, however, that the plates are so thick that two and sometimes three seeds get into a hole at once. The plates are made thick because they occupy the same space as plates for planting corn. One manufacturer of planters has arranged to make a thinner plate which will allow but a single kafir seed to enter. The remaining space will be occupied by a false plate.

Method of Planting.

Kafir may be surface planted with an ordinary corn planter or listed with either a single-row or two-row lister planter. That method should be used which experience has proved best for a given locality. As previously stated under the topic "Preparation of the seed bed," listing is preferable in soils subject to blowing. The young plants at the bottom of the lister furrow are protected from the cutting action of blowing sand or soil grains. In surface-planted crops a complete loss sometimes occurs from this cause.

CULTIVATING.

The kafir plant makes a slow growth while young and is easily choked by weeds. The cultivation of the crop should start early in the season and should be frequent enough to destroy all weeds and retain a surface mulch for holding moisture in the soil.

The spike-tooth harrow run either lengthwise or crosswise the rows in surface-planted kafir will give satisfactory results for the first two cultivations. The first harrowing should be done about the time the plants are appearing above the surface of the soil and the second one just before the plants are large enough to be satisfactorily worked with the row cultivator. The listed crop must be cultivated with the lister cultivator (fig. 7). For the first cultivation the disks are set to turn the soil away from the young plants, after which the disks are reversed to throw the soil toward the plants, thus filling the furrows and leveling the ridges as the cultivations continue. This process gradually buries the first-formed roots and the base of the plants and anchors the plants against overthrow by heavy winds when the ground is wet. It also places the root system deeper in the soil, where the moisture is more abundant and where it will be less

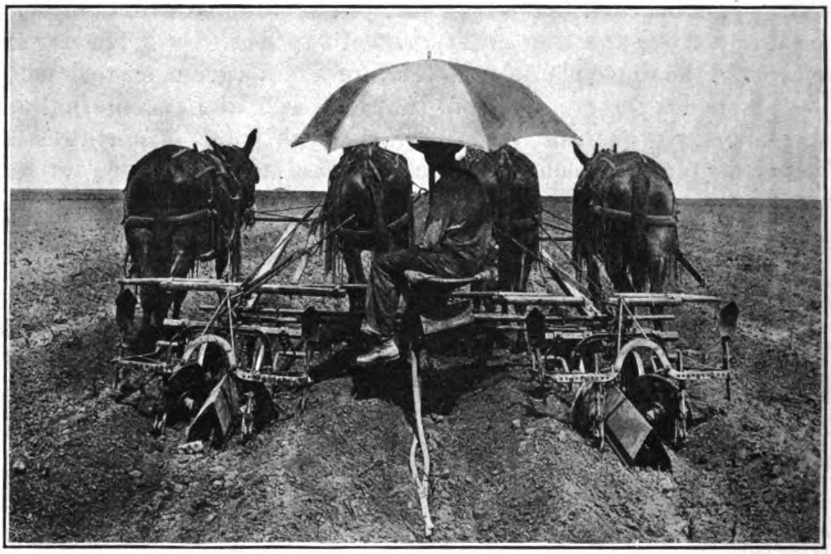

FIG. 7.—A 2-row lister cultivator in a field of very young kafir at the Hays branch station, Hays, Kans., July 12, 1911.

easily injured by the cultivator. After the ridges have been leveled any ordinary cultivator may be used.

While the plants are young the cultivation should be deep and thorough, thus encouraging a deep root system. Later it should be shallow, to retain a surface mulch and not damage or destroy the feeding roots.

HARVESTING.

The method used in harvesting this crop will vary with the immediate use that is to be made of it and also with the machinery available. It may be (1) cut and shocked in the field or (2) headed in the field.

In the first case the row binder (fig. 8) is commonly used, though cutting may be done with the sled cutter or by hand, as is frequently done with corn. It is then shocked, the size of the shocks varying with the preference of the individual farmer. Where the crop is headed in the field it may be done in any one of several ways, as (1) with the kafir header, (2) with the grain header, or (3) by hand.

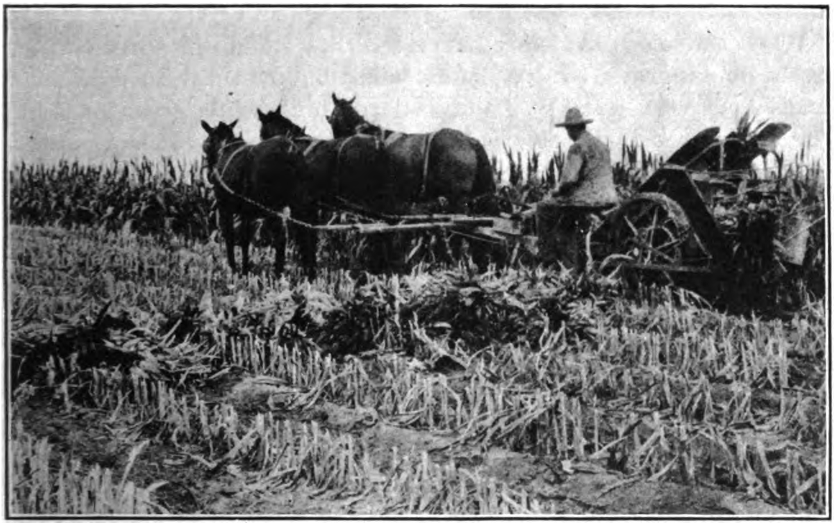

FIG. 8.—A row binder at work.

The kafir header, though made especially for this purpose, is not in general use and probably is no longer manufactured. The chief objections to it are its weight and the resulting difficulty of handling it, the inability to adjust it quickly to different heights of stalks in the same row or field, and the strain on the wagon body.

The grain header can be used successfully only on low-growing varieties, such as White kafir and Dwarf Blackhull kafir. The wheat farmers of western Kansas have used the grain header in this way for harvesting Dwarf milo and are now using it for Dwarf kafir. A 70-acre field was harvested with a 12-foot header in 1912 at the Hays branch experiment station, Hays, Kans., with complete success.

When hand heading is done, an ordinary pocket knife, a shoemaker's or farrier's knife, or pruning shears may be used. The head is grasped in the left hand and the stalk cut a few inches below the head by a single downward slicing stroke of the knife or a single clip of the shears. The head is thrown into a wagon box, just as the ear is in husking corn.

A satisfactory row header, running on its own gear and possessing easy and rapid adjustment to varying heights of stalk, would fill a long-felt want and doubtless would be a profitable invention.

CURING.

When the heads alone are harvested they should be spread in thin layers or windrows to dry before being bulked or thrashed. Kafir heads heat very quickly if put in large bulk while green or damp. The loss caused by heating is sometimes very great. It is a common practice where a considerable area is to be headed to start several long piles or windrows by putting down a 6 or 8 inch layer of heads successively in each, later adding another layer, a few days later another layer, and so on.

If the crop has been cut with a binder the bundles are put in shocks and allowed to cure for two to six weeks before the grain is thrashed. Kafir differs from most of the other sorghums in that the stalks and leaves remain green until after the grain is ripe. For this reason kafir requires a longer time to cure either in the bundle or head than other grain sorghums.

THRASHING.

An ordinary grain separator is used for thrashing the grain sorghums. Care is necessary to prevent cracking a large percentage of the kernels. If about half the concave teeth are removed and the speed of the cylinder reduced to about 800 revolutions a minute, comparatively little grain will be cracked. Grain is not injured but is rather improved for feeding purposes by cracking. If the seed is to be used for planting, however, the cracked grain is not only a loss but the quantity present makes it difficult to adjust the rate of seeding. Cracked grain is more likely to heat in storage, because it packs more closely and because it is more exposed to the action of molds. Usually the broken grains are split about in half and can not be readily fanned or screened from the whole grains.

Where the crop is cured in the bundle the heads are usually cut from the stalks before thrashing. This is done by means of a hatchet or a heavy knife, like a cleaver, or by a long knife hinged at the point and mounted on a frame or on the wagon box. Some farmers load the bundles, heads out, on a hayrack, and saw off the projecting heads with a hay knife.

STORING.

Since the grain in bulk heats so readily, great care must be used in storing it. As previously stated, it should be thrashed only when fully ripe and thoroughly dry. The storage problem on the farm is usually not serious. The bins are not likely to be large or very tightly constructed. If a large quantity is to be binned, however, it may be necessary to provide for some means of ventilating the center of the mass. This can be done by means of a wooden pipe or a long, narrow wooden box, perforated at intervals, built through the center of the bin and opening outside. The openings should be covered by a heavy wire screen.

YIELD.

Kafir yields in the dry-land areas vary from nothing to 50 bushels to the acre and occasionally go as high as 70 or 75 bushels. There is probably very little difference in the actual yielding power of the different varieties, though there is often great difference in their performance. There is considerable difference in the yields obtained in different localities, due to differences in elevation, latitude, soil, and normal rainfall. As large yields can not be expected on the high plains or the more northern plains with their shorter season and cooler nights as in the lower plains and more southern sections.

Yield is governed by seasonal conditions, however, more than by any other factor. In years of drought the yields are seriously lowered. In years of abundant moisture they become unusually high. Rainfall can not be controlled, but the amount of moisture in the soil can be greatly influenced by proper methods of tillage.

The use of dwarf and early varieties, such as the Dwarf Blackhull, will permit much better yields in dry seasons than can be obtained from varieties of standard height. The dwarf plant actually uses less water in growth. Earliness enables it to mature before a drought occurs. Combined dwarfness and earliness lower the water requirements and so permit the plant to continue growth, even in spite of drought, because the dwarf plant does not use water as fast.

Table I shows the comparative yields obtained from the different varieties at the Cereal Field Station at Amarillo, Tex., during a series of years. The yields given are the averages obtained from several plats, as stated in the second column.

TABLE I.—*Data showing number of plats, length of growing period, row space to one plant and to one stalk, and yield to the acre for the best plat and the average for all plats of kafir varieties grown at the Cereal Field Station, Amarillo, Tex., 1908 to 1912, inclusive.*

Year and variety.	Number of plats.	Growing period.	Row space.		Acre yield.	
			To 1 plant.	To 1 stalk.	Best plat.	Average of all plats.
1908.		*Days.*	*Inches.*	*Inches.*	*Bushels.*	*Bushels.*
White	1	101	...	...	...	...
Blackhull	14	115	12.2	7.8	42.2	33.8
Red	6	121	11.4	7.0	42.6	33.0
1909.						
White	1	...	13.8	9.9	8.7	8.7
Blackhull	18	...	12.4	9.9	10.9	4.2
Dwarf Blackhull	1	...	12.4	10.5	14.4	14.4
Early Blackhull	1	...	12.3	10.6	10.8	10.8
Red	11	...	11.0	8.1	10.7	3.8
1910.						
White	2	125	17.2	9.0	10.0	9.5
Blackhull	15	129	23.8	11.4	5.5	3.0
Dwarf Blackhull	2	127	22.5	8.4	9.7	9.3
Early Blackhull	2	128	20.5	7.5	9.3	8.4
Red	7	136	41.3	15.5	10.6	5.3
1911.						
White	2	124	8.5	5.7	26.3	25.0
Blackhull	15	127	7.9	5.0	26.5	18.8
Dwarf Blackhull	2	123	6.5	3.3	35.8	35.0
Early Blackhull	1	123	4.1	3.0	21.4	21.4
Red	7	132	12.9	8.5	24.3	18.7
1912.						
White	2	116	9.4	6.5	16.5	15.0
Blackhull	15	139	10.3	5.7	9.2	4.1
Dwarf Blackhull	7	135	9.9	5.9	17.8	13.6
Early Blackhull	1	134	6.5	4.9	8.0	8.0
Red	8	139	21.0	7.9	11.2	4.3

USES OF THE CROP.

Kafir furnishes a feeding grain, a combined grain and fodder crop, and a food for man.

A FEEDING GRAIN.

Kafir grain makes excellent feed for all classes of farm animals, including poultry. It is used as a substitute for corn in the ration and has a chemical composition very similar to that of corn; that is, it is rich in carbohydrates or fat formers and low in protein or muscle builders. It is therefore best fed in connection with some hay or foodstuff rich in protein. It is best to grind the grain before feeding for all stock except poultry. The starch is somewhat less digestible than is cornstarch, but, in general, kafir grain has a feeding value of 90 per cent or more of that of corn.

FEEDING IN THE BUNDLE.

A considerable quantity of kafir is fed in the bundle, unthrashed. This is partly because of a lack of separators in parts of the southern plains area and partly to save labor. The stover (fodder with heads removed) makes a good roughage when well cured, and many feeders supply both the grain and roughage at the same time by feeding in the bundle.

FOOD FOR MAN.

For many years farmers here and there have had kafir made into meal at their local mills and have used the meal in making batter cakes and similar foods. More recently experiments conducted cooperatively by the Bureau of Plant Industry and the Kansas State Agricultural College have shown that the meal can be used in much the same way as corn meal. Mixed with wheat flour in suitable proportions it can be used very acceptably in a great variety of dishes. This meal is now regularly manufactured and sold by one firm in the Southwest. The kafir grain can also be used as pop corn.

A1.9: 553

Issued September 22, 1913.

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 553.

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POP CORN FOR THE HOME.

BY

C. P. HARTLEY,
Physiologist in Charge of Corn Investigations,

AND

J. G. WILLIER,
Scientific Assistant, Office of Corn Investigations.

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1819

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1913.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., May 6, 1913.

Sir: I have the honor to transmit herewith a manuscript entitled "Pop Corn for the Home," by Mr. C. P. Hartley, Physiologist in Charge of Corn Investigations, and Mr. J. G. Willier, Scientific Assistant, Office of Corn Investigations, and recommend that it be published as a Farmers' Bulletin.

Respectfully,
Wm. A. Taylor,
Chief of Bureau.

Hon. D. F. Houston,
Secretary of Agriculture.

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B. P. I.—915.

POP CORN FOR THE HOME.[1]

INTRODUCTION.

Among the things that add pleasure to country life, pop corn should be given a prominent place. For affording a pleasant and healthful treat for the family during the long winter evenings and the holiday season it probably has no equal. The crisp, flaky pop corn is dear to the children's palate and the "pop corn and Christmas hemlock spurting in the fire" have been enjoyed by both old and young for many generations. If every farm home would keep a supply of pop corn and a popper convenient, fewer nickels would be spent for less wholesome knicknacks and more enjoyable evenings would be spent around the family hearth.

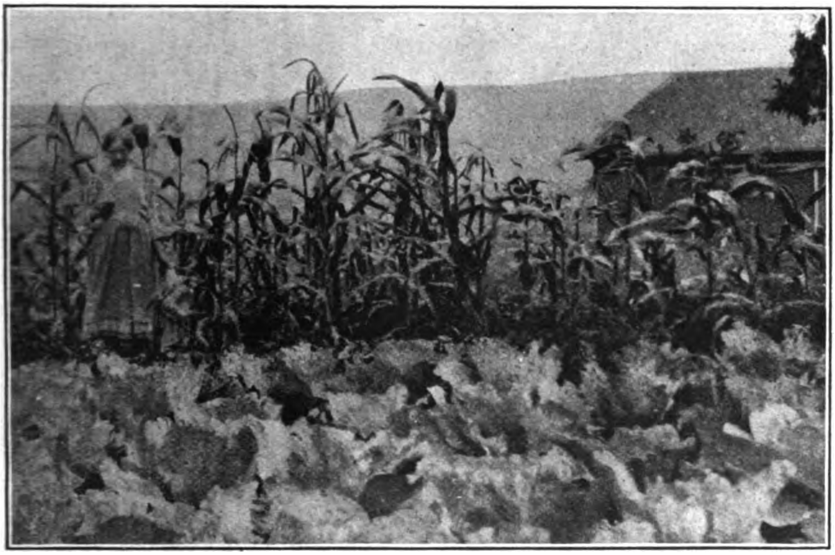

FIG. 1.—Pop corn in the garden.

Besides being a source of entertainment for the children, pop corn has considerable value as a food, and when properly prepared for the table it is superior to many of the breakfast foods now on the market.

---

[1] For information regarding the growing of pop corn on a commercial scale, see Farmers' Bulletin 554, entitled "Pop Corn for the Market."

553

THE HOME PLAT.

It is customary on many farms where it is not desired to grow pop corn as a market crop to plant a few rows of it in the garden for home use. This phase of farming usually interests the children and it is well to let them do the planting. Pop corn readily mixes with field corn and sweet corn planted near it, and as this mixing renders it unsuitable for seed purposes some of the old seed should be saved for next year's planting or good seed should be procured from some other source.

FIG. 2.—A high-school principal and his plat of pop corn.

If it is desired to grow pop corn as a field crop, the surplus stock that is not wanted for home use can usually be sold to local merchants at a fair price, or a profitable local trade may be built up by supplying it direct to consumers. Both of these methods should enable consumers to get a first-class article at a lower price than it would cost on the general market. This practice is to be encouraged, as it enables consumers to make their own pop-corn confections and thus have them fresh, in which state they are at their best, and when it is considered that $30 worth of popped corn in the form of 5-cent packages represents an outlay of only about $1 or $1.50 for raw material the economy of this practice is evident. Sufficient pop corn to make $30 worth of 5-cent packages of popped corn can be grown on a piece of land 40 feet long and 20 feet wide. See figures 1, 2, 3, and 4 for methods of planting pop corn in fields and gardens.

CHOICE OF A VARIETY.

There are a large number of varieties of pop corn, from which selection can be made to suit almost any desire or fancy. Seedsmen catalogue not less than two dozen different varieties, though in a number of cases the same variety is listed under various names by different dealers. Many prefer the colored varieties for home use and these usually please the children more than the standard commercial varieties shown in figures 5, 6, and 7. The ears of the Little Tom Thumb and the popped kernels of the Eight-Rowed varieties are popular for Christmas-tree decorations.

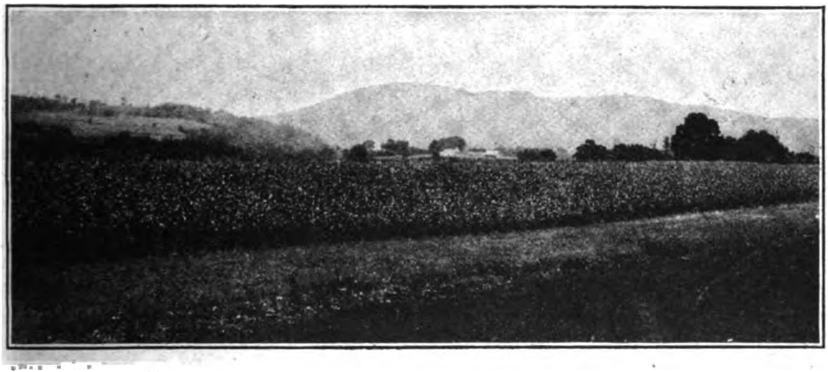

FIG. 3.—A pop-corn field in the Connecticut River Valley.

Almost any variety of pop corn will give satisfactory results if properly handled, and by the judicious selection of seed the chosen variety can be greatly improved.

PLANTING POP CORN.

In order to succeed best with pop corn for home use it should not be left until the field and truck crops have been planted, but should be planted early, so it will have a long season in which to grow and mature. If harvested in an immature condition it will not give as flaky and crisp pop-corn balls as can be made from fully ripened corn. A good time to plant is when the oak trees begin to show their new leaves. A warm, well-drained location, free from marshy places, should be selected. A sandy loam, if available, is best. The soil should be plowed or spaded to a depth of 8 inches or more and the surface of the plat thoroughly pulverized before planting. The rows should be about 3 feet apart. A small furrow 2 or 3 inches deep is sufficient. The kernels should be dropped 8 or 10 inches apart in the row and covered to a depth of about 1 inch. The planting should be done before the moist soil in the furrow has had time to dry out.

CARE OF THE GROWING CROP.

Grass and weeds should be kept down as much as possible while the corn is making its early growth, and the soil should be kept loose over the surface by frequent cultivation or hoeing. If only a small plat is planted it is better to plant a number of short rows, as this will admit of the silks becoming better pollinated and will give better filled ears than would result from the growing of one long row.

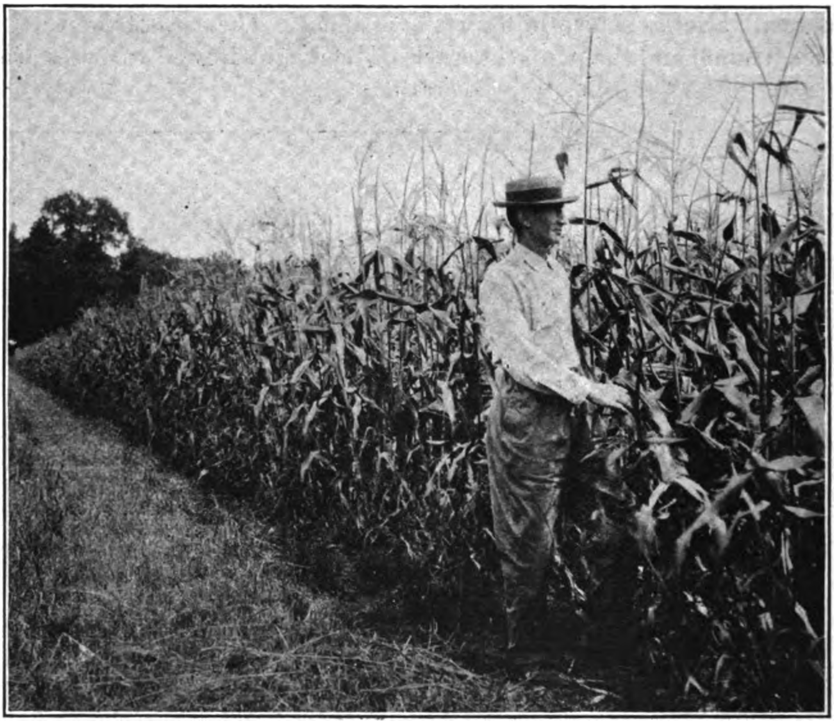

FIG. 4.—A field of White Rice pop corn in Vermont.

HARVESTING AND STORING POP CORN.

The ears should be husked from the standing stalk and should be spread out in a well-ventilated place to dry and cure. The ears should not be piled up in a large heap or sacked before they are well dried out. It is best to leave the corn on the stalks until the husks are white and dry and the stalks have lost their sappy condition. The ears may be stored in any place where the air can circulate around them freely and where they are safe from birds, mice, and squirrels. An overhead rack made of narrow slats or wire netting and suspended by wires in the wagon shed will be a good storing place for pop corn, or the ears may be strung up and suspended from rafters in the garret. Pop corn should not be stored in a warm or heated room, as it will dry out too much. Wire crates made of fine-mesh wire are convenient for storing it and afford protection against rats and mice.

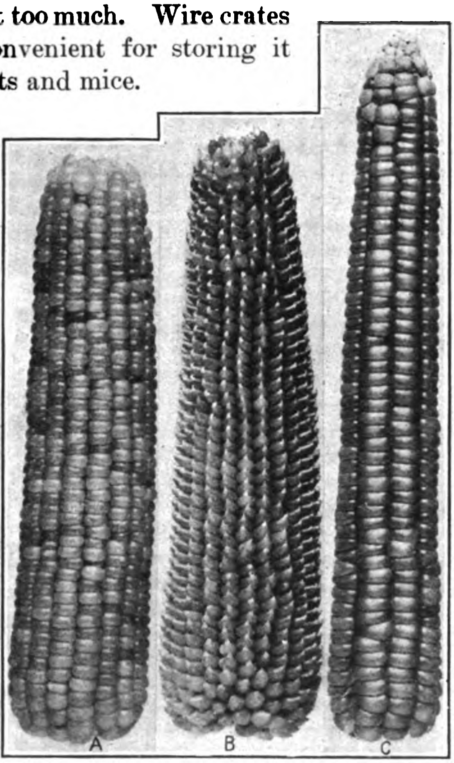

FIG. 5.—Ears of common varieties of pop corn: *A*, White Pearl; *B*, White Rice; and *C*, Eight-Rowed. White Rice, the leading variety of pop corn, is grown more extensively than any other kind. The large size of the popped kernels of Eight-Rowed makes this variety prized for Christmas decorations.

New pop corn may be used for popping as soon as it has dried out sufficiently. If properly stored it may be ready for use by Christmas. If old pop corn will not pop on account of having become too dry, the popping quality may be somewhat restored by moistening or sprinkling with water before popping. If very dry it should be soaked in water for awhile and then spread out to dry for a few days before using, or the dry corn may be put in a shaded place outdoors for a time, where it can absorb moisture from the open air. Pop corn usually pops best when it contains about 12 per cent of moisture. If the popping quality has been injured by freezing while yet green or immature, by harvesting before ripe, or by heating in curing, or if moths and weevils have damaged the corn the trouble can not be remedied by these methods.

HAND POPPERS.

In figure 8 are shown types of hand poppers. A popper like No. 1 can be used for popping corn in butter and lard. A common skillet supplied with a tin lid will answer the same purpose. No. 4 is a favorite style of popper and is carried in stock by many stores. It costs only 10 cents. The only objection is its small size. No. 3 is a satisfactory homemade wire popper.

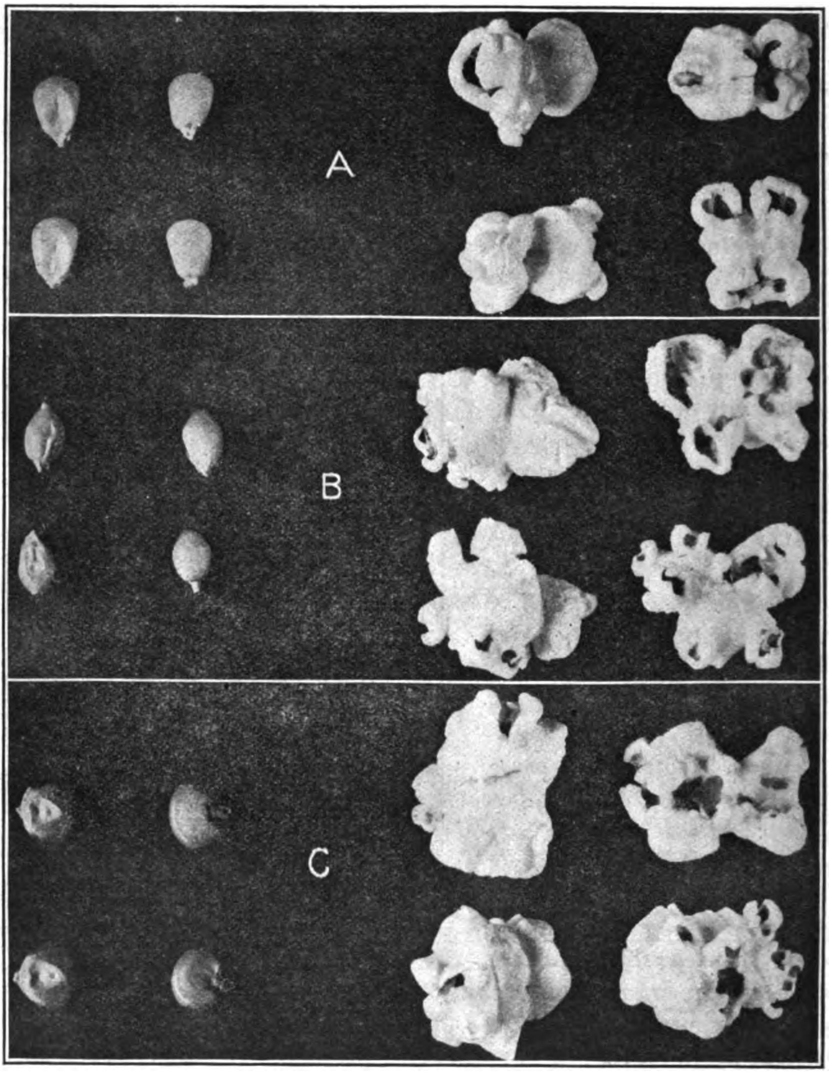

FIG. 6.—Unpopped and popped kernels of the principal varieties of pop corn: *A*, White Pearl; *B*, White Rice; and *C*, Eight-Rowed.

HOW TO POP CORN.

For good results in popping, the main requisites are good corn and a good hot fire. In popping, certain precautions may be observed to good advantage.

Do not take too much pop corn at one time, not more than enough to barely cover the bottom of the popper one kernel deep. Hold the popper high enough above the fire or heat to keep from burning the kernels or scorching them too quickly. The right degree of heat for best results in popping should make good corn begin to pop in 1½ minutes. This should give the maximum volume increase in popping. If it begins to pop in less time or if a large quantity of corn is put into the popper, it will not pop up so crisp and flaky. If it takes much longer for the popping to begin, the heat is probably not great enough or the pop corn is of poor quality, or there may be other interfering causes, such as drafts of cold air.

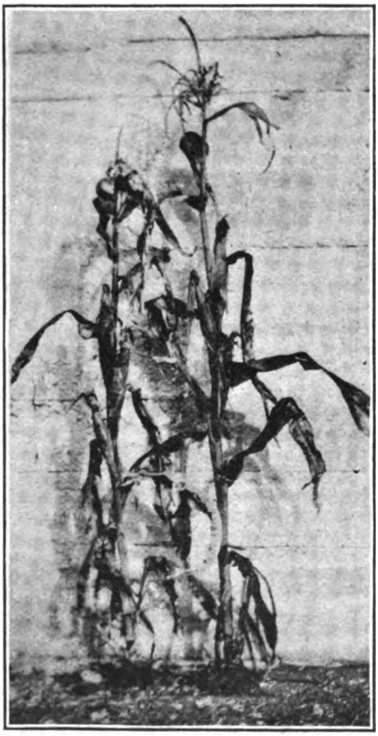

FIG. 7.—Stalks of White Rice pop corn.

To preserve the snowy whiteness of the popped kernels, the flame must be kept from striking them. This can be done by placing a plate of iron or a stove lid between the corn and the fire if a wire popper is used or by using a pan popper if popping directly over a flame.

If the pop corn is in first-class condition and the heat properly applied, 1 pint of unpopped corn should give 15 to 20 pints of popped corn.

HOME USES.[1]

Pop corn is usually popped to be eaten at once, or it may be made into pop-corn balls, crackajack, or other forms of pop-corn confection. A common way of preparing it is by popping and sprinkling it with salt or adding salt and melted butter. Sometimes the popped corn is eaten with milk and sugar like a breakfast food. The parched unpopped kernels when ground like coffee make a very good breakfast food for eating with cream and sugar or for boiling with water and serving like oatmeal. Some pop-corn venders make a palatable preparation by popping the corn in melted butter and lard with salt added.

---

[1] For information regarding the food value of pop corn, see Farmers' Bulletin 298, entitled "Food Value of Corn and Corn Products."

It is customary on some farms at butchering time in the fall to wind up the day's work by cooking a kettle full of pop corn. This is done by popping the corn in the greasy residue left in the kettle after the lard has been rendered. Salt is added to suit the taste and may be cooked in with the grease.

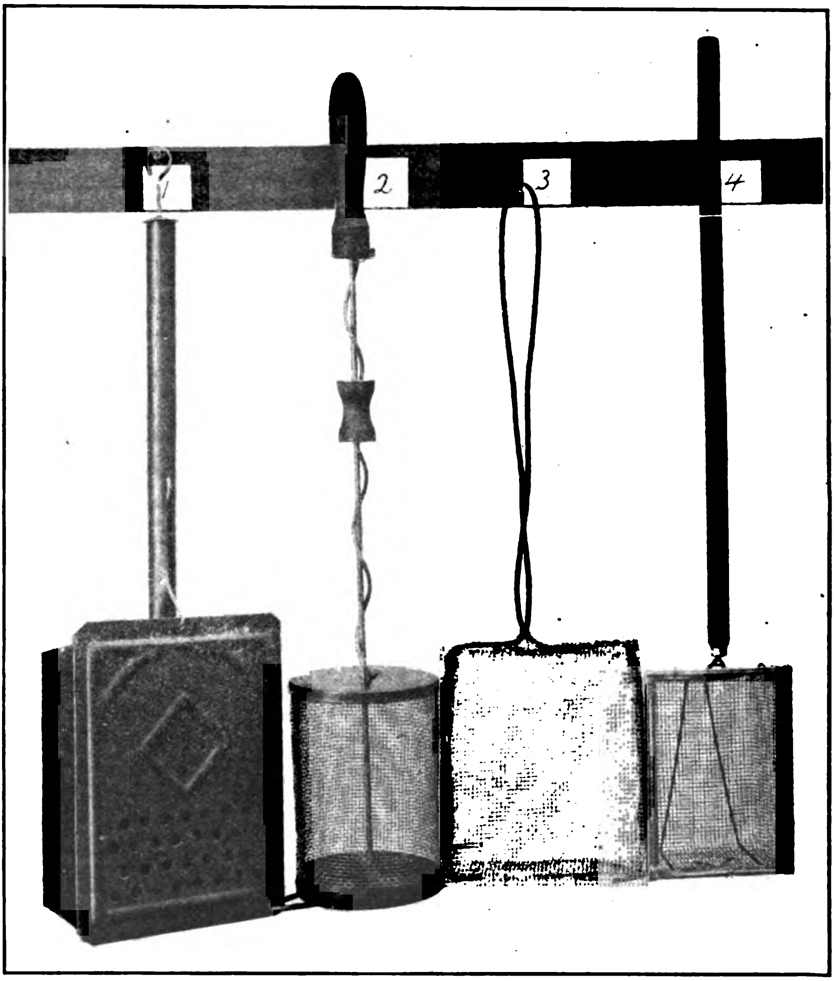

FIG. 8.—Four different types of hand poppers.

In many farmhouses the delicious pop-corn cake is considered a necessary adjunct to the Christmas festivities and is regarded as a superior article of food.

Dealers who put up shelled pop corn in 10-cent packages for the retail trade usually have a number of good recipes printed on the outside of the packages. Cookbooks also give splendid recipes for making pop-corn confections. The following have given good results:

CHOCOLATE POP CORN.

2 teacupfuls of white sugar.	2 ounces of chocolate.
½ cup of corn sirup.	1 cup of water.

Put these ingredients into a kettle and cook them until the sirup hardens, when put in cold water. Pour over 4 quarts of crisp, freshly popped corn and stir well to insure the uniform coating of the kernels.

SUGARED POP CORN.

Make a sirup by boiling together 2 teacupfuls of granulated sugar and 1 teacup of water. Boil until the sirup strings from the spoon or hardens when dropped into cold water. Pour over 6 quarts of freshly popped corn and stir well.

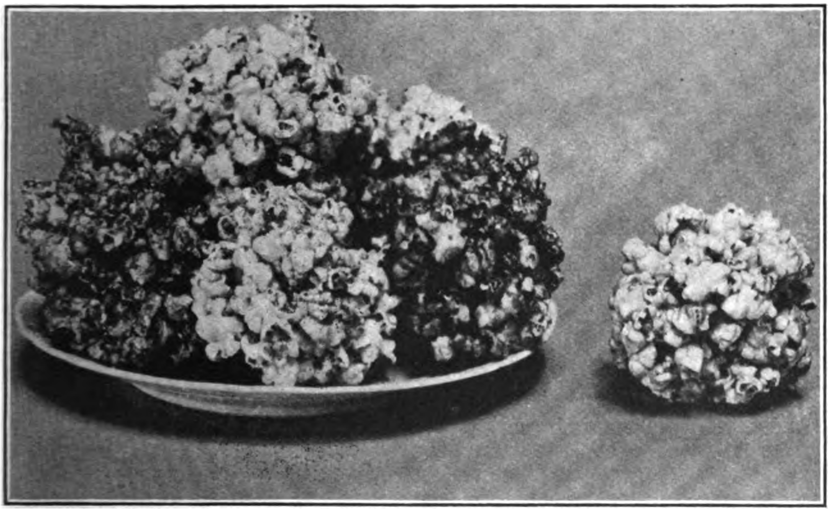

Fig. 9.—Homemade molasses and sirup pop-corn balls.

POP-CORN BALLS.

1 pint of sirup.	2 tablespoonfuls of butter.
1 pint of sugar.	1 teaspoonful of vinegar.

Cook till the sirup hardens when dropped into cold water. Remove to back of stove and add one-half teaspoonful of soda dissolved in a tablespoonful of hot water and then pour the hot sirup over 4 quarts of freshly popped corn, stirring till each kernel is well coated, when it can be molded into balls or into any desired form.

The pop-corn balls shown in figure 9 were made by this last recipe. The darker balls were made by using New Orleans molasses and the lighter colored ones by the use of maple sirup. Any good sirup or molasses can be used.

A1.9:554

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U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 554.

POP CORN FOR THE MARKET.

BY

C. P. HARTLEY,
Physiologist in Charge of Corn Investigations,

AND

J. G. WILLIER,
Scientific Assistant, Office of Corn Investigations.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1913.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., May 6, 1913.

Sir: I have the honor to transmit herewith a manuscript entitled "Pop Corn for the Market," by Mr. C. P. Hartley, Physiologist in Charge of Corn Investigations, and Mr. J. G. Willier, Scientific Assistant, Office of Corn Investigations, and recommend that it be published as a Farmers' Bulletin.

Respectfully,

Wm. A. Taylor,
Chief of Bureau.

Hon. D. F. Houston,
Secretary of Agriculture.

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POP CORN FOR THE MARKET.[1]

DESCRIPTION OF POP CORN.

The principal characteristic that serves to distinguish pop corn from other kinds of corn is the tendency of its kernels to evert, or turn inside out on being heated. This peculiarity has given rise to the scientific name of *Zea everta,* by which term pop corn is known to the botanist. It differs from the flint type of corn in having a larger proportion of corneous endosperm or horny substance constituting the starchy portion of the kernel. The ears and kernels are smaller than those of field corn and the stalks more slender and more inclined to exhibit a purple color. Most varieties ordinarily bear more than one ear to the stalk. There does not appear to be any record of the origin or early history of pop corn, but evidences seem to indicate that it was grown by the Indians.

VARIETIES OF POP CORN.

TYPES AND CLASSES.

There are two well-defined types of pop corn—the rice type, with sharp-beaked kernels, and the pearl type, with smooth or rounded kernels. Each of these two types may be subdivided into a number of different classes or varieties, according to color and according to size and time required to mature. The subdivision of these two types according to these characters has given some 25 or more varieties of pop corn.[2]

There is no demand for the colored varieties. Some of these have excellent popping quality and good flavor, but as the popped kernels do not completely hide the colored hull they do not make as attractive an appearance as the white varieties. The less coloring matter there is in the hull or seed coat the prettier will be the snowy white mass of popped kernels.

Of the pearl type the principal varieties are the Common White Pearl, Queen Golden, and Eight-Rowed. All of these are grown to a limited extent as compared to White Rice. The Silver Lace and Mapledale varieties are selections of White Pearl. Because of the large size of its popped kernels the Eight-Rowed variety is in demand at Christmas time for decorative purposes.

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[1] For information regarding home uses of pop corn, see Farmers' Bulletin 553, entitled "Pop Corn for the Home."

[2] In Bulletin 57, Office of Experiment Stations, United States Department of Agriculture, Sturtevant describes 25 varieties of pop corn.

Descriptions are also given by Halsted in the Report of the Botanist, New Jersey Agricultural College Experiment Station, 1906.

THE LEADING VARIETY.

The White Rice is grown most extensively and is preferred on the large markets and by pop-corn venders. This variety is usually listed by dealers under the common name of White Rice. Some seedsmen have selected strains which they offer under special names, as Improved White Rice, Snowball, Early White Rice, Monarch White Rice, Old Homestead, etc.

EXTENT OF PRODUCTION.

Pop corn is grown in practically all of the States. The main portion of the market supply, however, comes from a few States in the section known as the corn belt. Table I, compiled from census figures, shows the production and value of the crop for the leading pop-corn-producing States in 1909.

TABLE I.—*Production of pop corn in 1909, by States.*

State.	Farms reporting.	Acres grown.	Bushels produced.	Value.
Iowa	428	5,345	197,322	$135.270
Nebraska	213	2,167	51,130	33,854
Illinois	189	998	....	28,994
Kansas	193	520	9,191	9,245
Ohio	172	439	....	16,878
Michigan	200	362	....	12,443
California	59	361	....	10,184
Indiana	109	357	12,466	12,337
New York	188	344	....	13,697
Minnesota	73	266	5,419	5,340
Wisconsin	54	184	8,762	7,044

Table II gives the production by counties for the year 1909. Only the leading pop-corn-producing counties are shown.

TABLE II.—*Pop-corn production, by leading counties, in 1909.*

State and county.	Farms reporting.	Acres grown.	Bushels produced.	Value.
Iowa:				
Sac	192	3,098	117,505	$79,415
Ida	74	1,535	58,490	36,390
Nebraska:				
Valley	74	1,303	31,698	18,032
Greeley	19	309	6,260	4,056
Knox	8	97	2,260	1,604
Illinois:				
Carroll	3	128	....	2,660
Gallatin	6	121	....	1,680
Lasalle	4	97	....	3,383
Kansas:				
Shawnee	4	48	1,590	1,120
Bourbon	3	32	1,266	1,071
Ohio:				
Montgomery	20	70	....	1,752
Lorain	8	36	....	1,500
Michigan:				
Monroe	15	46	....	2,816
California:				
Los Angeles	40	310	....	8,887
Indiana:				
Laporte	4	48	1,354	1,090
Dearborn	3	47	2,966	1,782
New York:				
Wayne	7	25	....	1,498
Minnesota:				
Lyon	5	90	1,470	1,270
Wisconsin:				
Racine	10	53	2,273	1,404
Kenosha	7	44	2,510	1,795

In Iowa the principal centers of production were at Odebolt, Arthur, Idagrove, Battle Creek, Schaller, and Wall Lake, and in Nebraska at Arcadia, Bloomfield, North Loup, Ord, and Scotia. Pop corn was also grown commercially at Mapleton, Oakland, and Topeka, in Kansas; Burlington and Waterloo, in Wisconsin; Chadwick, Eureka, Gilman, and Paris, in Illinois; Harrison, Ohio; and at various other points in these and other States.

POPPING QUALITY.

THEORY OF POPPING.

The exact nature of popping is not well understood. Formerly it was supposed to be caused by the expansion of oil in the kernel on being heated, but at the present time it is believed to be due to the expansion of the moisture contained in the starch cells. The general belief now is that on the application of heat, as from a good bed of coals, this moisture expands with sufficient force to cause an explosion of the cells and the kernel turns completely inside out, enveloping the embryo and hull. It is probable that the expansion of the air within the seed coat also has something to do with the popping. The seed coat should be sufficiently dry and hard to afford much resistance to expansion.

FACTORS INFLUENCING THE POPPING QUALITY.

Hereditary influences.—Careful tests have shown that the pollination of white pop corn with pollen from yellow field corn affects the flavor, texture, and color of the popped kernels that were cross-pollinated. In other words, the planting of good, pure pop corn within 10 or 20 rods of field corn is likely to ruin both kinds for seed and injure the popping quality of the pop corn.

Physical conditions.—To give satisfactory results in popping, corn should ripen fully on the standing stalk before frost comes and should then be stored where it will have sufficient ventilation, so it will not heat in curing. The kernels should be practically free from soft white matter in the endosperm and should have a moisture content of about 12 per cent. If properly stored, pop corn will retain its popping quality for a number of years.

INCREASE IN VOLUME DUE TO POPPING.

Good grades of pop corn will increase in volume from twelve to twenty times on popping. In popping there is usually more or less waste, due to imperfections in the kernels, slow or uneven application of heat, or other causes. Factories have reported from 7 to 25 per cent of waste in commercial grades of pop corn.

CULTURE OF POP CORN.

SOIL.

Any soil that is adapted to field corn will produce pop corn. For best results the soil should be fertile and well drained. The crop prefers a soil of the sandy-loam type. Avoid low muck or peat soils, as they tend to retard maturity in the fall. Where grown for commercial purposes pop corn usually takes the place of the ordinary field corn in a rotation. Pop corn, oats, and clover make a good rotation, planting the pop corn on the clover sod. The clover may be sown with the oats. The land may be plowed in the fall or early spring. Old sod land, however, should be plowed in the fall, to expose the worms and other insects to the freezing temperature of winter.

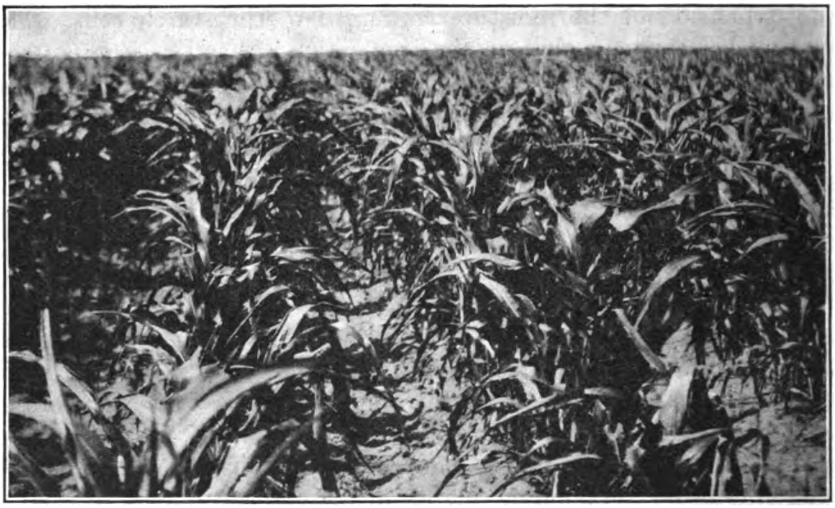

FIG. 1.—A field of drilled pop corn, planted too thick for best results. Note the curling of the blades due to the thick stand and dry weather.

PLANTING AND CULTIVATING.

Pop corn should be planted early, so it will have a long season in which to grow and mature. It is advisable to plant as soon as the ground is warm enough for good germination of the seed. The seed bed should be thoroughly harrowed and pulverized. The rows may be laid off about 3½ feet apart and the kernels dropped so the plants will stand from 8 to 10 inches apart in the row. If it is desired to cultivate the pop corn both ways, a stand of three or four plants per hill with the hills 3 feet 4 inches apart each way will be thick enough. Pop corn has a strong tendency to sucker when planted thinly, especially on rich ground (figs. 1 and 2).

From 2 to 4 quarts will plant an acre, depending on the size of the kernels and the thickness of planting. A quart of White Rice pop corn contains about 7,000 kernels. There will be 3,920 hills per acre if the hills are 3 feet 4 inches apart each way. If planted at

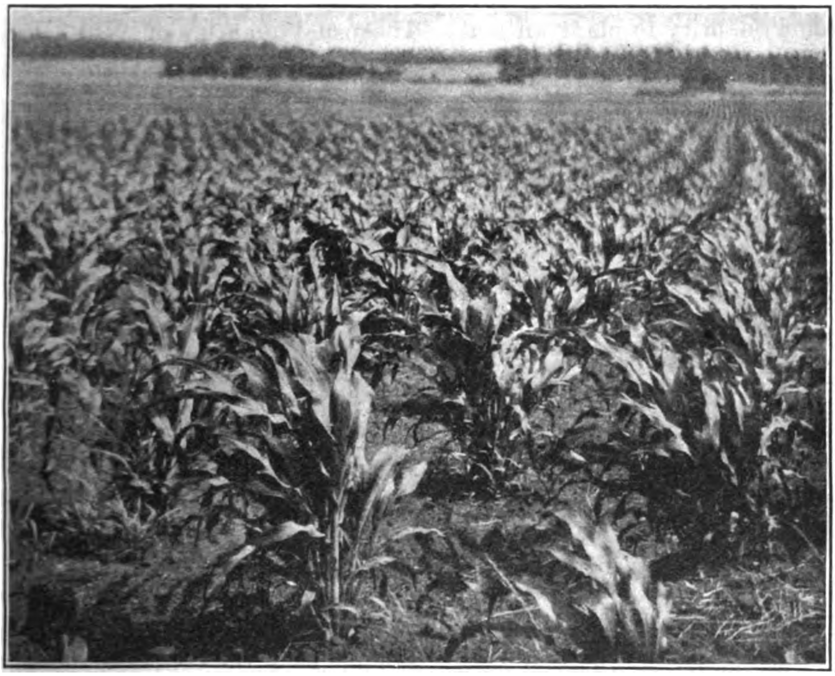

FIG. 2.—A field of pop corn planted in hills. Pop corn has a stronger inherent tendency to sucker than field corn; on rich ground it often suckers profusely.

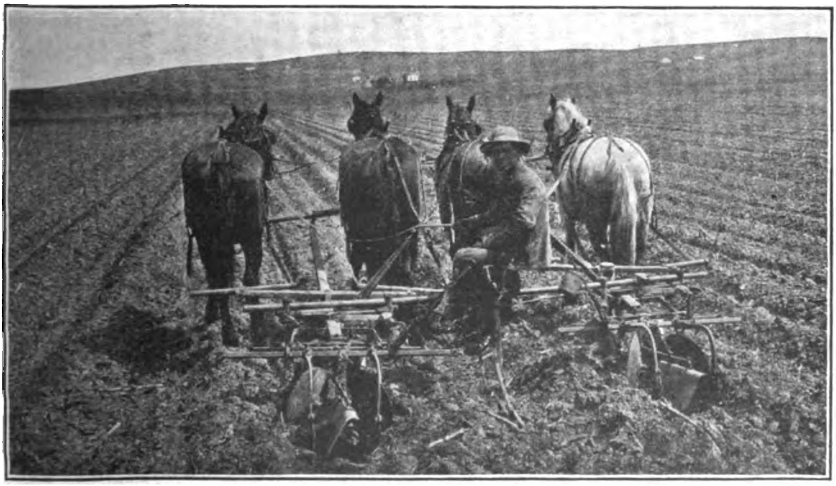

FIG. 3.—A 2-row cultivator used on listed pop corn. The middle row is cultivated on the return trip.

the rate of 4 kernels per hill, it will take 15,680 kernels, or a little over 2 quarts, to plant an acre of 3,920 hills. If the kernels are dropped 8 inches apart in rows 3½ feet apart, it will take about the same quantity to plant an acre. The usual quantity of White Rice pop corn planted per acre is about 5 pounds.

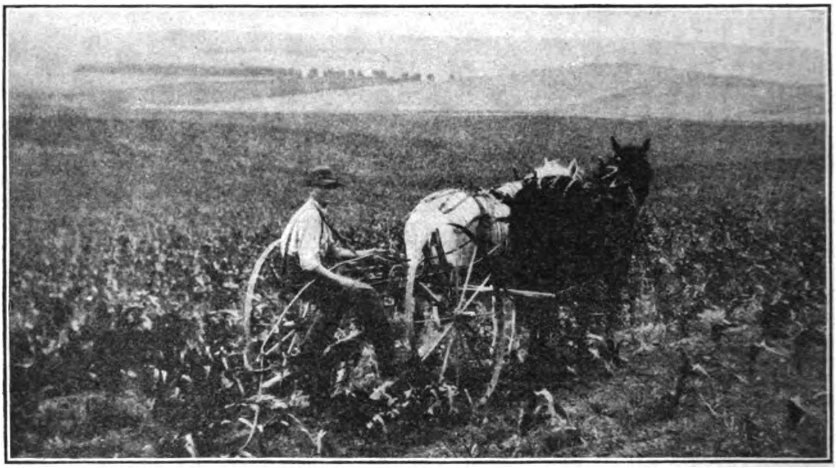

FIG. 4.—A shovel cultivator.

An ordinary corn planter may be equipped with the special plates necessary for planting pop corn. For planting the common rice pop corn the holes in the plates should be three-eighths of an inch in diameter, countersunk on one side.

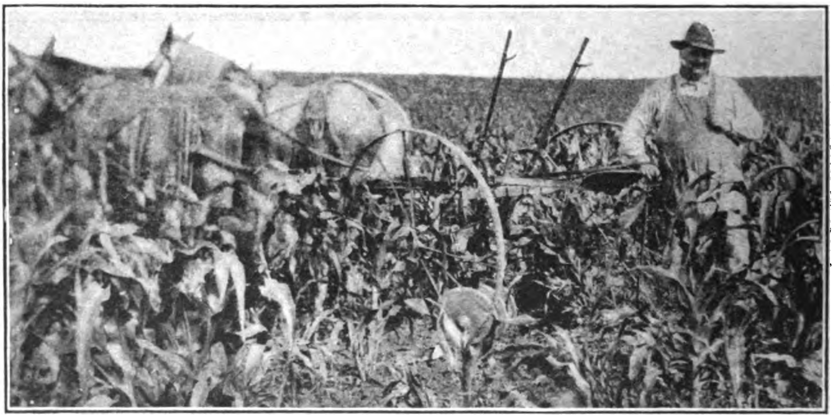

FIG. 5.—A disk cultivator used for cultivating pop-corn fields.

Begin cultivation as soon as the plants are a few inches high. Repeat the cultivation every week or 10 days, and oftener if heavy rains cause the surface to become crusted. Prepare a deep seed bed before planting and cultivate shallow after planting. For types of cultivators see figures 3, 4, and 5.

RIPENING.

Pop corn ripens in 100 to 130 days from planting. The ripening may be hastened by liberal applications of a phosphatic fertilizer, but is sometimes retarded by the use of too much stable manure. It should ripen before frost comes; otherwise its popping quality will be injured and it will then have little value for marketing.

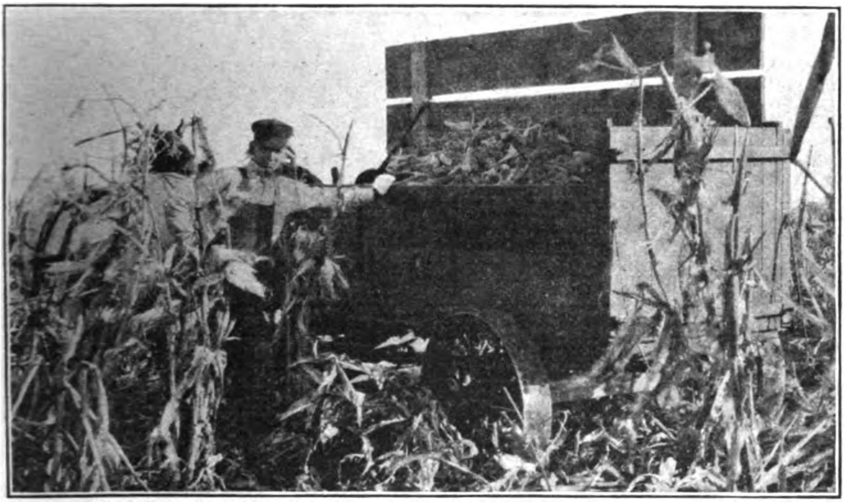

FIG. 6.—Picking pop corn by hand from the standing stalks.

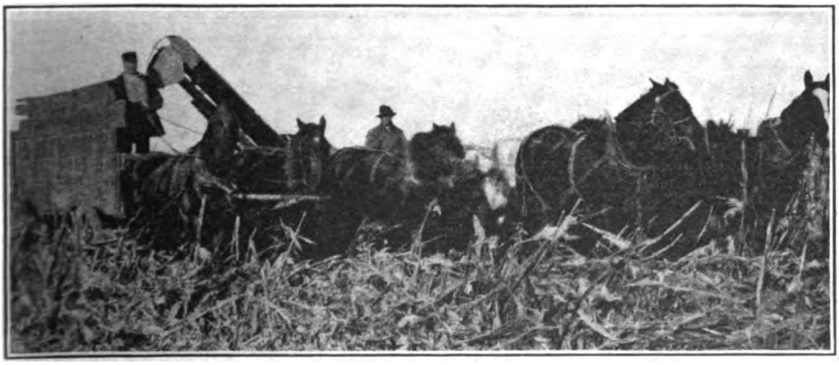

FIG. 7.—Gathering pop corn with a modern corn-harvesting machine.

HARVESTING AND STORING.

The crop can be harvested as soon as it has fully matured and the husks have whitened, provided the ears are not bulked, but are so placed that they will dry quickly. The best quality of pop corn is obtained by allowing the ears to ripen fully and dry out as much as possible on the standing stalks. Cutting the stalks with a corn binder and standing the bundles up in shocks in the field to allow the pop corn to cure is not recommended. The most satisfactory way of harvesting is by hand from the standing stalks (fig. 6). Some farmers use a modern corn harvester (fig. 7), and in some sections pop corn is husked from the shock (fig. 8).

The husked corn should be stored in well-ventilated cribs where it can cure without heating (figs. 9, 10, and 11). If the crib is wide, a special A-shaped ventilating device should extend through the middle of the crib lengthwise, and provision should also be made for ventilating crosswise (fig. 12). If pop corn is not supplied with a free circulation of air while curing it is likely to heat, and this heating will injure the popping quality and also the food value.

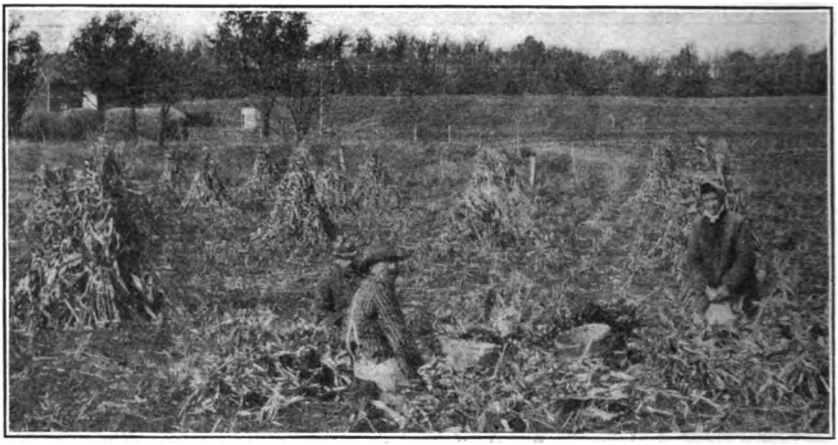

FIG. 8.—Husking pop corn from the shock in order to save the stover.

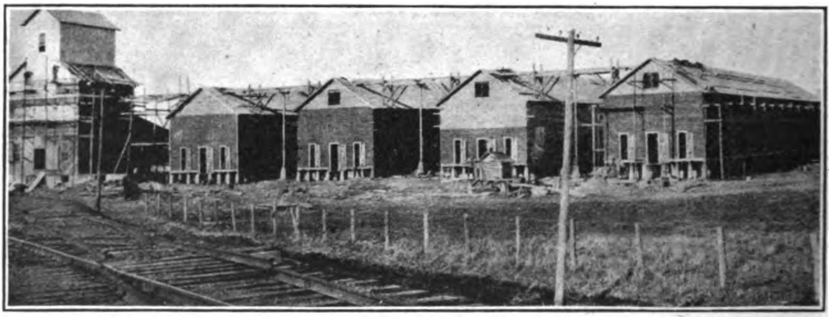

FIG. 9.—Elevator and pop-corn cribs at Arthur, Iowa. Each crib has a capacity of 18,000 bushels of ear corn.

MARKETING.

Pop corn will not be ready for marketing until the summer following the season in which it is grown. Manufacturers say it should not be put on the market before June 1. Growers often sell their crop by the pound on the ear to elevator men, who store it in cribs and shell it as needed for the market. In some cases farmers sign contracts at the time of planting in which they agree to deliver the yield of entire fields at harvest time at so much per pound of ears. Some growers have well-constructed cribs of their own in which they store the crop and sell direct to the consumer. This enables the growers to hold their crop until it can be marketed advantageously. Pop corn is usually shelled and put up in 100 or 150 pound bags for the trade. Many prefer a cylinder sheller for shelling pop corn.

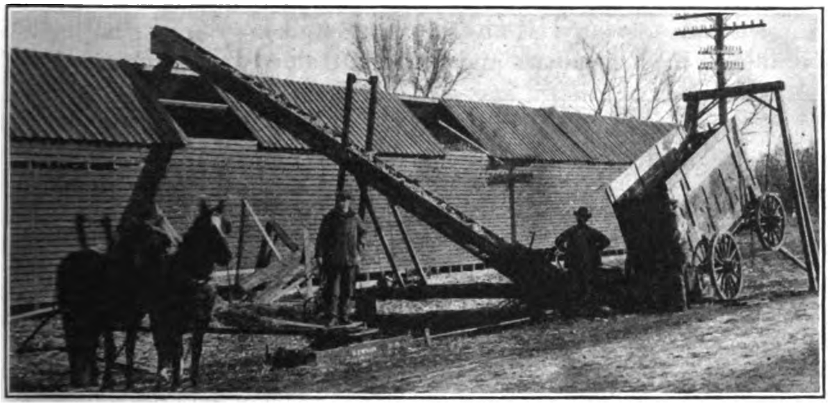

FIG. 10.—Elevator men taking in the crop at time of harvesting, Odebolt, Iowa.

Where grown for local markets, as in the Eastern States, it is usually sold at from 1½ to 3 cents per pound of ears, and storekeepers retail it at from 5 to 10 cents per pound of ears or in pound boxes, shelled, at 10 cents a pound.

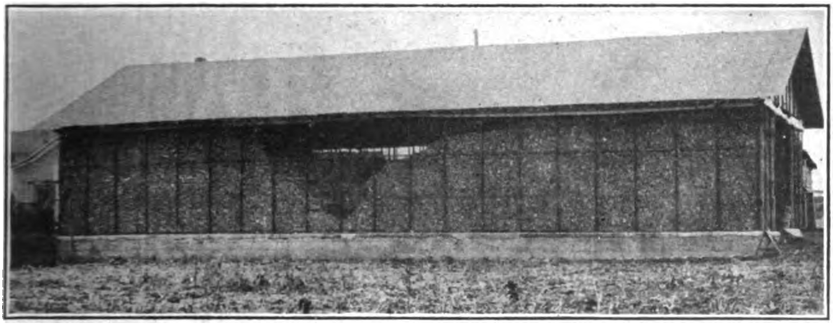

FIG. 11.—A rat and mouse proof crib having a concrete foundation, an iron frame covered with wire netting, and storm curtains on sides and ends.

The market prices of pop corn vary considerably from year to year. In 1908 the market price was as low as three-fourths of a cent per pound, and in 1912 as high as 6 cents per pound.

In most States the weight per bushel is the same for pop corn as for field corn, 56 pounds shelled or 70 pounds of ears, air-dried, constituting a bushel. One hundred pounds of ears should give 80 pounds of shelled pop corn.

SEED PLAT.[1]

It is advisable to have a seed plat planted with exceptionally good seed and in an isolated location to furnish seed for the next year. In this plat all weak, barren, or otherwise inferior stalks should be detasseled just as soon as the tassels appear and before they have shed any pollen. At harvest time the rows should be gone over and the seed ears selected from the best stalks. Early maturity is desirable in most localities and can be attained by taking seed each year from good early-maturing stalks. It is not necessary to procure new seed from a distance each year for planting; neither is it advisable to do so. Pop corn will not be at its best until fully acclimated, which takes several years, and for this reason home-grown seed is to be preferred. The yearly planting of a seed plat with seed from the best stalks of the previous crop will improve the strain at the same time it is becoming adapted to the soil and climatic conditions of the locality.

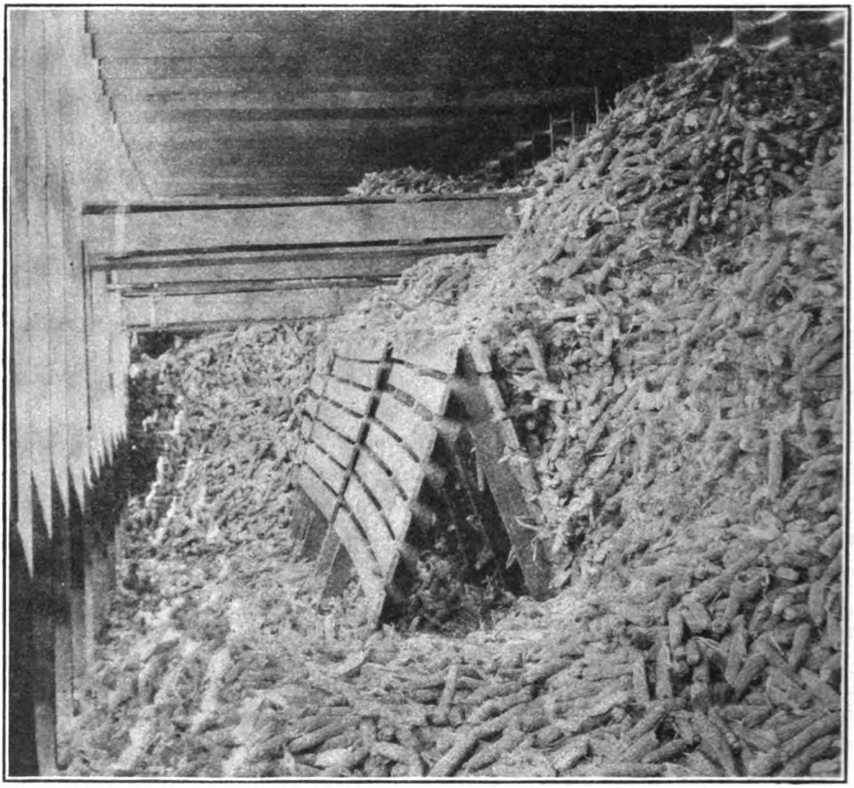

FIG. 12.—Interior of a pop-corn crib. Note the ventilating devices running lengthwise and crosswise. The sections of the ventilators are removed as the crib is emptied.

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[1] For a fuller discussion of the seed plat, see Farmers' Bulletin 229, entitled "The Production of Good Seed Corn," and for information regarding the care of seed corn, see Farmers' Bulletin 415, entitled "Seed Corn."

MARKET SUPPLY OF POP CORN.

PRODUCTION.

The main portion of the crop which finds its way to the large markets is grown in a few localities in Iowa and Nebraska by farmers who make a specialty of producing and handling pop corn. Usually from 10 to 50 acres are grown on single farms, the pop corn taking the place of field corn in the rotation.

During the past much of the crop was grown on contract, but at present farmers are becoming more independent. Many have cribs of their own in which they store and cure their crop and take chances on the market price rising higher than the contract price or the price at harvest time. In Iowa and Nebraska elevator men have been accustomed to buying up the bulk of the crop at harvest time and selling it to manufacturers, commission merchants, and jobbers.

USE.

The market supply is taken by manufacturing establishments that turn out crackajack (crackerjack) and other forms of pop-corn confectionery, by pop-corn venders, and by dealers who supply local trade. Venders usually handle roasted peanuts in connection with pop corn. Shelled pop corn in 1-pound pasteboard packages sells extensively in New England for home popping.

POP-CORN PRODUCTS.

A large quantity of pop corn is used annually in the manufacture of pop-corn package goods. In these the popped corn is coated with a preparation of sugar, glucose, and molasses, and in some cases with chocolate. Some packages contain small quantities of peanuts, and in others both peanuts and sliced coconut are mixed with the pop corn. These confections are put on the market under special trade names and usually sell for 5 cents per package. Other pop-corn preparations are corn bar, sugar-coated pop corn, pop-corn balls, and pop corn bricks. The pop-corn package goods familiarly known as crackajack (crackerjack), etc., have become quite popular and are sold in large quantities at parks, summer resorts, picnics, fruit stands, stores, railroad stations, and on trains.

EXPORT TRADE.

The export trade in pop corn is as yet in its infancy. Small shipments of pop corn were made from several of our ports during the past year and some popping machines were exported. This phase of the industry needs to be encouraged.

DOES IT PAY TO GROW POP CORN?

The question "Does it pay to grow pop corn?" is frequently asked, and the answer to it is "Yes." It pays to grow pop corn, but owing to the limited market for this crop it would not be advisable to begin its culture on a large scale. The supply at present just about equals the demand. No farmer should expect to become rich in a few years' time by growing pop corn. If the good years are averaged up with the poor ones this crop will be found to pay about as well as field corn. Any farmer in the corn-producing States can produce pop corn, but the profit depends largely upon the producer's ability to grow pop corn of good quality, store his crop properly, and market it advantageously.

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U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

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COTTON ANTHRACNOSE AND HOW TO CONTROL IT.

By W. W. Gilbert,
Pathologist, Office of Cotton and Truck Disease and Sugar-Plant Investigations, Bureau of Plant Industry.

INTRODUCTION.

Cotton anthracnose, quite commonly called boll-rot, is a serious enemy to the cotton crop, largely because of the fact that methods of control are not generally known. This bulletin describes the disease and sets forth the most effective means of reducing the damage from it.

The disease was first described by Atkinson and Southworth in 1891. At that time its distribution and prevalence were not well known, though it had been reported from several States.

Within the past few years the disease has been studied by several pathologists, and it is now known to occur annually to a greater or less degree throughout the cotton-growing sections of the country. It has been reported from all parts of Mississippi, including the different soil types found in the Delta and bottom lands, where it is the worst, as well as in the sand-hill and prairie regions of the State. It occurs in every county in South Carolina and appears to be on the increase. The disease is reported as present in every cotton field in the State of Georgia. Specimens of the trouble are received each year from all parts of the cotton belt, and, though some sections appear to be less affected than others, its occurrence is very general.

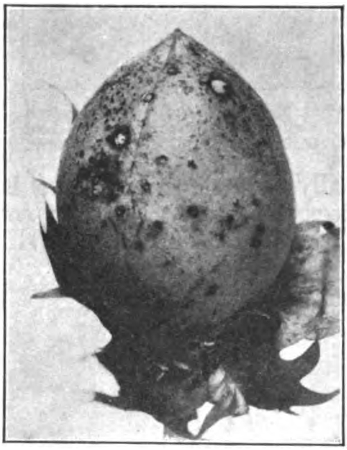

FIG. 1.—Early stage of cotton boll-rot, showing the small, dark, sunken spots; also two spots with pink spore masses in the center.

DESCRIPTION OF THE DISEASE.

Anthracnose attacks the cotton bolls, the young seedlings, the stems, and the boll pedicels.

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BOLL-ROT.

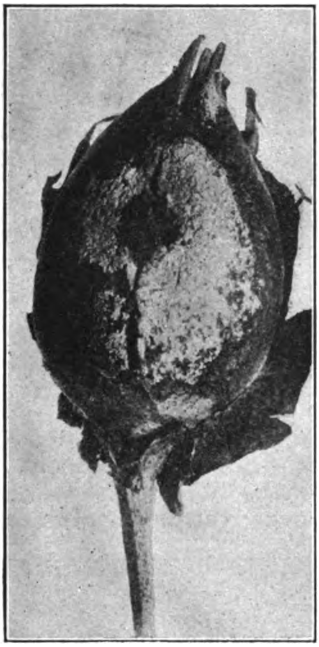

Fig. 2.—A boll of Sea Island cotton badly diseased with anthracnose and covered with a mass of pink spores.

The boll injury, commonly called boll-rot, is the most apparent and probably the most serious form of the disease. Minute round spots of a dull reddish color are the first visible indications of the trouble. (Fig. 1.) As they enlarge, the center at first becomes black, but later, if weather conditions are favorable, anthracnose spores are produced in abundance, beginning at the center, and the spots then take on the characteristic pink color, surrounded by a narrow border of dull red, which shades off to the normal green of healthy tissue. (Fig. 2.) In very dry weather the spores are produced sparingly and the spots are gray to black instead of pink. The spots enlarge to a half inch or more in diameter and where several coalesce irregular diseased areas are formed, which sometimes involve the entire boll. If the bolls are attacked when very young, they may be killed or the affected side dwarfed, while the other side continues nearly normal growth, resulting in the production of a one-sided boll which opens incompletely. When the disease attacks partly matured bolls, two or more locks often stick together and fail to open. In still other cases only a small diseased spot is visible externally, but the whole or a large part of the interior of the boll is decayed and little or no cotton is produced. (Fig. 3.) Any lock that is affected, however slightly, produces discolored cotton which sticks to the bur; the lint is weak and worthless and lowers the grade of the whole picking, while the seed from every such lock will either

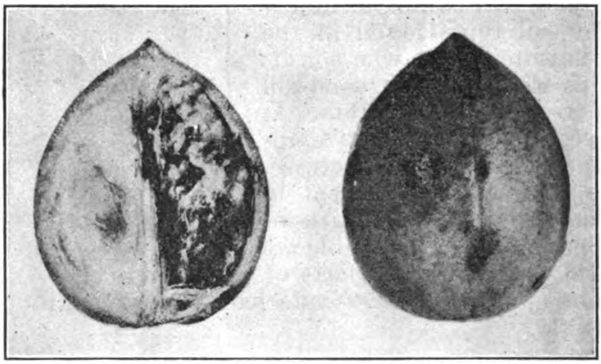

Fig. 3.—A diseased cotton boll, showing only a small spot on the outside, yet the entire lock is decayed by anthracnose.

be destroyed or penetrated by the disease, so that it will act as a source of infection to the succeeding crop should it be used for planting. The interiors of badly diseased bolls decay and become inhabited by insects, which are in many cases considered by farmers to be the cause of the rot.

Another boll-rot caused by bacteria (*Bacterium malvacearum*) can be distinguished from typical anthracnose by the following differences: In the early stages the diseased spots are merely water soaked and greenish and have no border line of red; later, the central portions turn black, shrink, and dry up, but do not become pink unless also infected with anthracnose. The bacterial boll-rot usually spreads more rapidly than anthracnose and frequently involves the entire boll, causing it to turn black and to fail to open. The trouble almost always attacks the leaves as well, causing the disease known as angular leaf-spot, due to the production of angular, water-soaked, diseased areas on the leaves.

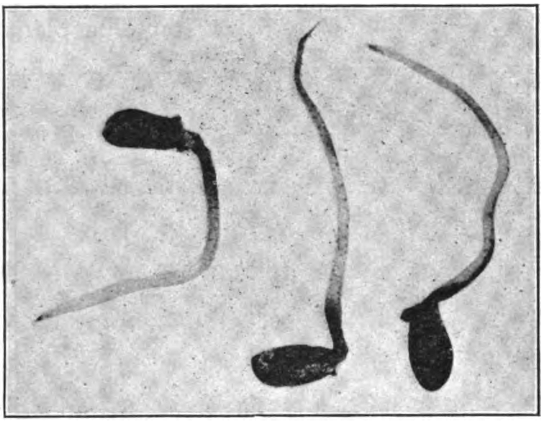

FIG. 4.—Seed from anthracnose-diseased cotton bolls sterilized externally and germinated in sterile Petri dishes. The fungus grew out from underneath the seed coats and attacked the sprouts at the black areas.

SEEDLING INJURY.

Anthracnose also attacks the young seedlings, killing the sprouts of badly infected seed before they appear above the ground or causing a damping-off near the soil of plants 2 to 4 inches high during periods of cold weather unfavorable to the growth of cotton. (Figs. 4 and 5.) In still other cases the seed leaves may be injured. Many broken stands are undoubtedly due in part to anthracnose killing the seedlings from infected cotton seed.

Damping-off due to anthracnose must be distinguished from "soreshin" caused by the attacks of Rhizoctonia. The former attacks the seedlings at or just below the surface of the soil, causing them to wither and die much as if they had damped-off. The tissue reddens and shrinks, frequently in longitudinal lines. "Sore-shin" causes well-defined ulcers or diseased depressions of a brownish color on the stems of seedlings just below the surface of the soil. These are frequently outgrown, unless they have penetrated too deep into the interior tissues.

STEM INJURY.

Anthracnose sometimes attacks and kills the pedicels of bolls and causes the bolls to dry up and drop off. The disease on the stems of the cotton plant produces elongated areas which are at first dull red, then black, and finally take on a pink color when the spores are produced. Affected branches are thereby weakened and are often broken during windstorms. Injury of this sort is sometimes associated with the presence of the bacterial disease known as black-arm, the anthracnose being secondary and accentuating the injury caused by the former.

CAUSE OF ANTHRACNOSE.

Anthracnose is caused by the attacks of the fungus *Glomerella gossypii.* This fungus is a moldlike plant growth of microscopic size, which penetrates the boll, seed, or seedling with its threadlike branches and causes the death of affected tissues. Two kinds of spores, microscopic seedlike bodies, are produced. The conidia are produced by the millions in sticky masses on the diseased seedlings, stems, or bolls and form the pink covering so characteristic of the disease. (Fig. 6.) The perfect or ascospore stage of the fungus has been found by Edgerton (figs. 7 and 8) on immature diseased bolls in Louisiana. Shear and Wood have also reported finding it in pure culture. No other report of the occurrence of the perfect stage either in culture or in nature has been made.

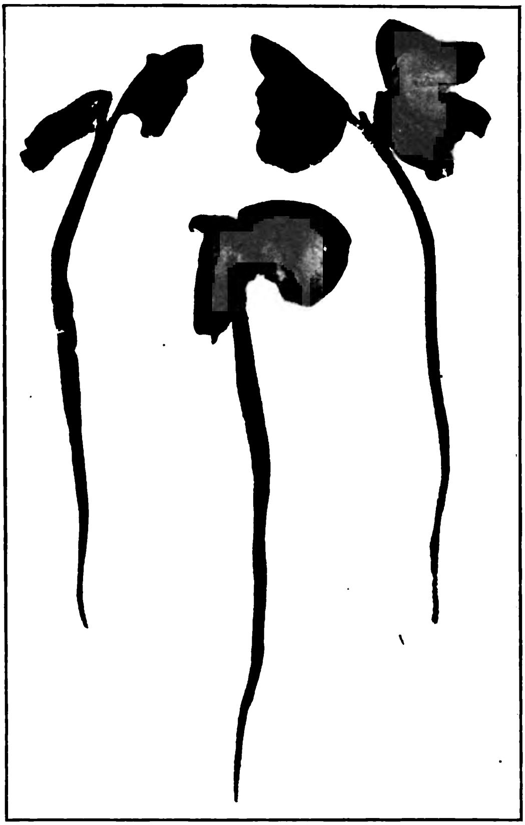

FIG. 5.—Cotton seedlings attacked by anthracnose on the darkened areas of the stems.

After penetrating the wall of the growing boll the fungus develops readily in the immature lint, finally penetrates the seed coats, and the disease may thus be carried over winter in the seed. The presence of the fungus in the seed was demonstrated by the writer in unpublished experiments made in 1905, when seed secured from anthracnose-diseased bolls were sterilized externally and then germinated in sterile Petri dishes. The fungus grew out of the seed and attacked and killed the seedlings, as shown in figure 4. More recently Barre has secured similar results from the germination of diseased seed and has also found the fungous filaments in the interior of the seed by means of paraffin sections.

Anthracnose-affected cotton bolls are so generally inhabited by insects, particularly by a small brown bug (*Carpophilus dimidatus*), that many farmers believe them to be the cause of the disease. They have no causal connection with the trouble, but merely find the decaying boll an excellent feeding and breeding place.

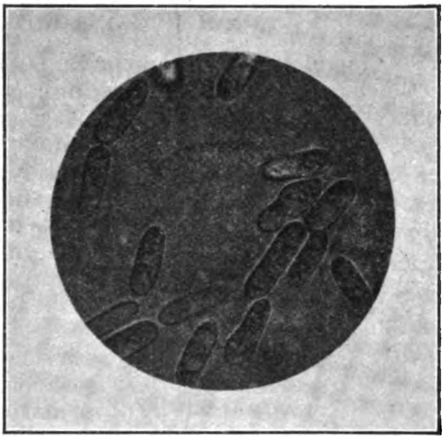

Fig. 6.—Conidia of *Glomerella gossypii* from a pure culture on beef agar. (Magnification, 625 diameters.)

VITALITY OF THE FUNGUS.

It has been proved by Barre that the anthracnose fungus may live on diseased bolls in the soil for 12 months, but in no case has it been known to live longer under field conditions. This has an important bearing on methods of control, as it would appear that a 1-year rotation would be sufficient to free an infected field from the disease.

In the seed, however, the fungus has been known to live as long as three years, and the disease is thus carried from year to year and from place to place. This fact emphasizes the importance of selecting seed for planting which is free from disease.

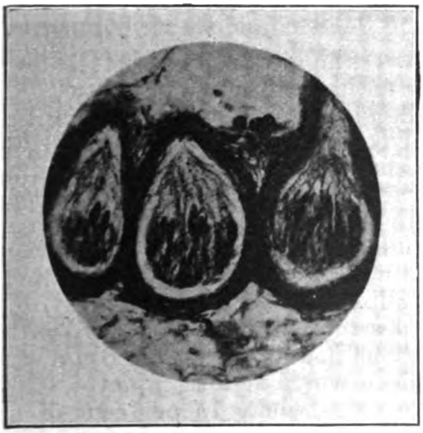

Fig. 7.—Perithecia of *Glomerella gossypii*, photographed from type slide. (Magnification, 200 diameters.)

MEANS OF DISSEMINATION.

Anthracnose is spread by means of the fungous mycelium and spores in and on the seed and on bits of diseased bolls or stems left in the field in the fall. The pink spores first formed on the bolls are produced in sticky masses, which on drying adhere to the diseased areas, and in this condition can not readily be blown about by the wind. During rainy weather, however, these spore masses soften up and the spores are scattered about by the wind and raindrops.

Insects are also doubtless active agents in carrying the spores from plant to plant, as the sticky masses readily adhere to their feet and mouth parts. In an experimental way Barre has obtained more than 40 per cent of infections from spraying the spores into open flowers. This means of transmission may readily be effected by bees and other insects feeding alternately on the sticky spore masses and on the flower honey.

Anthracnose is also spread at the cotton gin. Spores of the fungus are left in the machine by badly diseased lots of cotton, and these adhere to the seed of the next lot ginned. Seed for planting, which is otherwise free from disease, may thus be thoroughly infected.

CONDITIONS FAVORING ANTHRACNOSE.

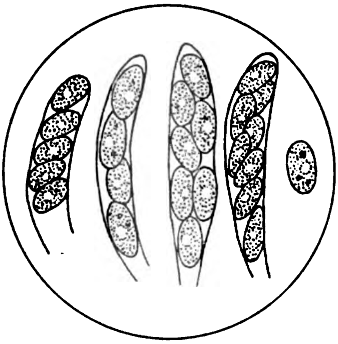

FIG. 8.—Asci and ascospores of *Glomerella gossypii*. (After Edgerton.)

The development of anthracnose on cotton is dependent on the presence of the causal fungus in or on the seed planted or in the soil. Cold, wet weather a few days after planting furnishes conditions unfavorable to the cotton seedlings and favorable to this fungus. During such periods many badly infected seeds have their sprouts killed even before they have come up, as shown in figure 4, and plants 2 to 3 inches tall are attacked and killed by the anthracnose fungus. On the bolls and stems anthracnose thrives during warm, rainy periods or in fields where a rank growth of cotton from too high fertilization or too close planting furnishes shade and moisture. Bolls that come in contact with the soil are also more liable to injury for the same reason. The disease will sometimes occur when some of these conditions are absent, but in such cases a severe infection or a very susceptible variety is responsible for serious injury.

EXTENT OF LOSS.

Loss from anthracnose is due to (1) the killing of cotton seedlings, resulting in a broken stand; (2) the entire destruction of bolls; (3) the partial destruction of bolls and discoloration of the remaining lint, causing a reduction of grade; and (4) the injury to stems and boll pedicels. The financial loss from the disease is difficult to estimate, as its occurrence and severity vary in different localities. Occasionally the loss is as great as 80 to 90 per cent on individual farms, while on adjoining places little trouble is experienced. Losses varying from 5 to 20 or 30 per cent and in some cases 50 to 75 per cent of the crop have been reported from all sections of the cotton belt. As early as 1896 Atkinson noted the destruction of 10 to 50 per cent of the cotton crop on certain plantations in the vicinity of Brundidge, Ala., though this was the only place where serious injury was observed. Southworth reported two cases where 75 per cent of the crop was destroyed, but states that in general the loss is from 10 to 25 per cent. In 1910 the loss in South Carolina alone was estimated at $4,000,000. Careful estimates of losses on individual farms in that State made in 1911 by Barre showed that the disease destroyed from 10 to 60 per cent of the crop. These estimates were made on fields of 25 to 800 acres located in different sections of the State. On 20 other farms, comprising an area of 1,800 acres, the total loss was estimated at $10,000. A conservative estimate of the total annual loss for the State is placed at more than $1,000,000, or about 1¼ per cent of the crop. The average annual value of the cotton crop of the United

States for the five years 1907 to 1911, inclusive, was $803,460,000. Placing the annual loss from cotton anthracnose over the whole cotton belt at 1 per cent, a very conservative figure, the total money value of the crop destroyed by this disease would reach $8,034,600.

REMEDIAL MEASURES.

The results of experiments to date indicate that damage from anthracnose is very largely preventable. The methods available for the reduction of loss are (1) the selection of planting seed free from disease; (2) the rotation of crops, combined with fall plowing; and (3) the use of varieties least susceptible to the disease.

SEED SELECTION.

The careful selection of seed for uniformity of type and for qualities of high commercial value is rapidly becoming a fixed farm practice. If this selection is to be most effective it must include also the factor of resistance to or freedom from disease. In dealing with anthracnose, because of the fact that the fungus is carried in the seed it is of supreme importance that seed shall be saved for planting only from fields where the least possible disease is present and only from bolls which are entirely free from the trouble. It is also desirable to select for picking only such plants as show no signs of boll-rot. Only by observing these precautions can disease-free seed be obtained. Excellent results have been secured from seed selection, even where as high as 20 per cent of anthracnose was present in the field where the seed was selected. Cotton from such seed, planted on anthracnose-free land, gave no sign of disease, while unselected seed from the same field planted on the noninfected land produced a crop which had an abundance of boll-rot. When seed has been carefully selected for freedom from disease, every precaution must be taken to avoid reinfection. Gins to be used for such seed should be thoroughly cleaned before the selected cotton is ginned.

Care must also be exercised in buying seed to make sure that it is free from anthracnose infection. Seedsmen should pay greater attention to seed selection, so that this disease may not be spread in the seed they sell. It is now unlawful to bring seeds for planting into the State of South Carolina, or to ship them within the State if they are infected with anthracnose.

No form of seed treatment yet devised will free diseased seed from the fungus, since any chemical which will kill the fungus beneath the seed coats will also kill the seed.

CROP ROTATION.

Since it has been proved that the anthracnose fungus can survive in the field on diseased bolls for at least a year, rotation of crops is almost as important as seed selection as a means of reducing damage from this disease, while at the same time conforming with the best farm practice. The planting of cotton on land where anthracnose was prevalent the previous season should never be practiced, for in such fields the disease is sure to be materially increased. It has been found that the planting of infected land in other crops for but one year very largely reduces the amount of infection and makes it possible to grow cotton successfully the following year. In cases where the disease has been very severe the burning of the stalks in the fall is advisable.

Fall plowing in connection with crop rotation has also been found helpful in freeing the land from disease infection. Furthermore, a considerable reduction in the amount of anthracnose has followed the growing of a winter cover crop on diseased fields between the cotton crops.

RESISTANT VARIETIES.

It is a well-known fact that cotton varieties differ markedly in their susceptibility to anthracnose injury, though no variety is entirely immune. However, since the factor of seed infection is always to be considered, it is not safe to judge from a single test whether marked freedom from anthracnose in a variety is due to inherent disease resistance or merely to absence of seed infection. Disease-free seed even from a very susceptible variety planted on noninfected land would produce a healthy crop unless it were infected from adjacent diseased cotton. Different tests have given varying data as to the susceptibility and resistance of varieties, owing to the lack of uniformity in seed, in soil infection, and in weather conditions. The best that can be done is to choose varieties which have shown the greatest disease resistance combined with other essential qualities and to avoid those most susceptible to disease.

Several variety tests that have been carried on agree in placing the Cook, Brown, and Blue Ribbon among the varieties most susceptible to anthracnose injury. The Columbia, Allen Long-Staple, Keenan, Hardin, Half-and-Half, and sometimes the Triumph, have also shown themselves more than ordinarily subject to injury from the disease. In other tests the Triumph has been fairly free from boll-rot. The same tests have placed the Toole, Poulnott, King, Dixie, and Dillon among those most free from anthracnose. Other varieties usually resistant to the disease are the Cleveland, Russell, Truitt, and Rowden, though these have been known to show considerable boll-rot.

SUMMARY.

Cotton anthracnose occurs throughout the cotton belt and causes an annual loss of several million dollars.

The disease attacks and kills seed and seedlings and causes a serious rot of the bolls.

Anthracnose is caused by the fungus *Glomerella gossypii*, which is propagated by spores carried in or on the seed and by insects.

The fungus can live on dead bolls in the field for at least a year and in the seed for two or three years.

Boll-rot is favored by warm, rainy weather and by too close planting.

Remedial measures consist of the selection of healthy seed for planting, the rotation of crops, and the use of varieties known to be resistant to anthracnose.

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THE MAKING AND FEEDING OF SILAGE.

MAKING AND FEEDING SILAGE . . T. E. Woodward.
SILAGE FOR HORSES . . . . . . George M. Rommel.
SILAGE FOR BEEF CATTLE . . . . W. F. Ward
SILAGE FOR SHEEP . . . . . . E. L. Shaw

MAKING AND FEEDING SILAGE.

By T. E. Woodward, *of the Dairy Division.*

SOME POINTS IN FAVOR OF SILAGE.

Within the last 30 years silage has come into general use throughout the United States, especially in those regions where the dairy industry has reached its greatest development. Silage is universally recognized as a good and cheap feed for farm stock, and particularly so for cattle and sheep. There are several reasons for the popularity of silage.

1. More feed can be stored in a given space in the form of silage than in the form of fodder or hay.
2. There is a smaller loss of food material when a crop is made into silage than when cured as fodder or hay.
3. Corn silage is a more efficient feed than corn fodder.
4. An acre of corn can be placed in the silo at less cost than the same area can be husked and shredded.
5. Crops can be put in the silo during weather that could not be utilized in making hay or curing fodder.
6. More stock can be kept on a given area of land when silage is the basis of the ration.
7. There is less waste in feeding silage than in feeding fodder. Good silage properly fed is all consumed.
8. Silage is very palatable.
9. Silage, like other succulent feeds, has a beneficial effect upon the digestive organs.
10. Silage is the cheapest and best form in which a succulent feed can be provided for winter use.

11. Silage can be used for supplementing pastures more economically than can soiling crops, because it requires less labor, and silage is more palatable.

12. Converting the corn crop into silage clears the land and leaves it ready for another crop.

SILAGE CROPS.

Almost any green crop can be successfully made into silage if sufficient care is taken to force out the air from the material. On account of the difficulty, however, of expelling air from plants with a hollow stem, such as timothy, oats, and barley, these crops are rarely put in the silo.

CORN.

In all parts of the United States where the silo has come into general use the principal silage crop is corn. One reason for this is that ordinarily corn will produce more food material to the acre than any other crop which can be grown. It is more easily harvested and put in the silo than any of the hay crops, such as clover, cowpeas, or alfalfa. These crops are much more difficult to handle after being cut. Furthermore, corn makes an excellent quality of silage. Sorghum makes a sour silage, and the legumes, such as clover and alfalfa, are liable to rot unless special care is taken to thoroughly pack the silage and force out the air. The fermentations which take place in leguminous silage are more extensive and in consequence the loss of food materials is greater than with corn.

The only objection which has been raised concerning corn silage is the fact that it contains insufficient protein to fully meet the requirements of animals to which it may be fed. Some persons have advised mixing clover, cowpeas, or alfalfa with the corn when it is being put into the silo in order to correct this deficiency of protein. Such a procedure is not to be advised, however, if it is at all possible to cure the clover or other crop into hay, and it usually is possible if hay caps are used. Since some dry forage should always be fed along with the silage, the leguminous hay would better be used in this way rather than by converting the crop into silage.

VARIETY TO PLANT.

The best variety of corn to plant is that which will mature and yield the largest amount of grain to the acre, since the grain is the most valuable part of the corn plant. The variety commonly grown in any particular locality for grain will also be the most satisfactory to grow for silage. As will be seen from the table below, taken from the First Annual Report of the Pennsylvania State College, 63 per cent of the digestible food materials present in the corn plant are found in the ears and 37 per cent in the stover.

Yield of digestible matter in corn.

Constituent.	Yield per acre.		
	Ears.	Stover.	Total crop.
	Pounds.	*Pounds.*	*Pounds.*
Protein	244	83	327
Carbohydrates	2,301	1,473	3,774
Fat	125	22	147
Total	2,670	1,578	4,248

CULTIVATION AND YIELD.

Corn for silage may be planted and cultivated in the same manner as when grown for grain. Weeds should be kept out, else they will be cut with the corn and may impair the quality of the silage. The yield of corn silage per acre will vary from 4 or 5 to 20 tons or more. A 50-bushel per acre crop of corn will yield about 8 to 12 tons of silage per acre, depending upon the amount of foliage and stalk that accompanies the ear. Southern varieties of corn as a rule carry a larger proportion of the plant in the form of stalk and leaves than do the northern-grown varieties. Figure 1 shows a good field of corn.

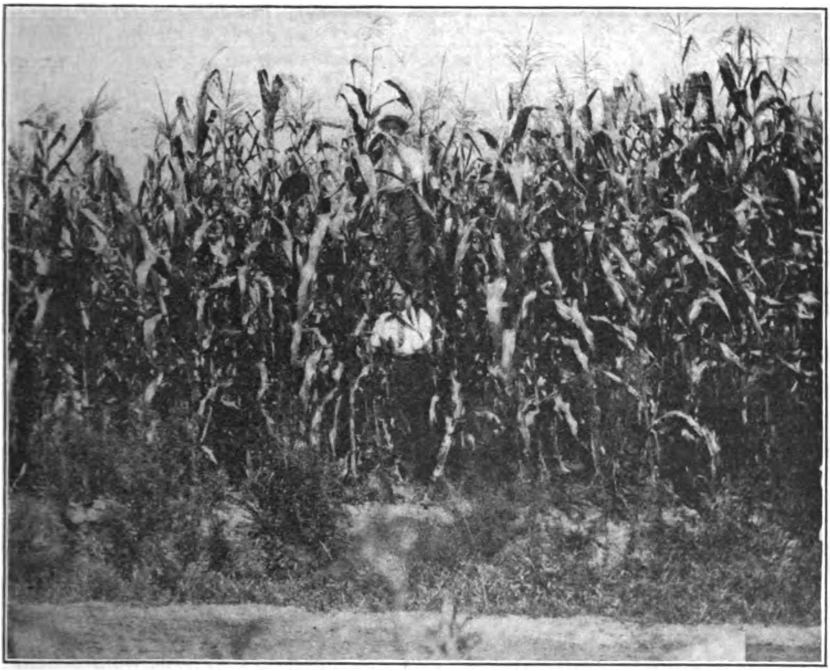

FIG. 1.—A good field of corn.

TIME TO HARVEST.

Corn should be harvested for the silo at about the same time that it is harvested for fodder—that is, when the grain has become glazed and the lower leaves of the stalk have turned brown. The following table taken from the Eighth Annual Report of the New York Experiment Station will furnish valuable information as to the proper time to cut corn for the silo:

Chemical changes during growth of corn plant.

Yield per acre.	Stage of growth.				
	Tasseled July 30.	Silked Aug. 9.	Milk Aug. 21.	Glazed Sept. 7.	Ripe Sept. 23.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Total yield	18,045	25,745	32,600	32,295	28,460
Water	16,426	22,666	27,957	25,093	20,542
Dry matter	1,619	3,078	4,643	7,202	7,918
Ash	138.91	201.30	232.15	302.48	364.23
Albuminoids	239.77	436.76	478.69	643.86	677.78
Crude fiber	514.19	872.93	1,261.97	1,755.85	1,734.04
Nitrogen-free extract	653.91	1,399.26	2,441.29	4,239.82	4,827.60
Fat	72.20	167.75	228.90	259.99	314.34

The table shows that there is a steady increase in the amount of dry matter and food ingredients in the corn plant up to the time it is ripe. Immature corn is a poor feed, whether fed fresh or as silage. The protein and carbohydrates especially undergo changes from the immature to the mature stage which increase their food value. Silage made from immature corn is not only less nutritious but also more acid than that made from more mature corn. The corn should not be allowed to become thoroughly ripe and dry, however, because the stalk and foliage are rendered more difficult to digest, and, besides, the corn can not be packed into the silo tightly enough to prevent "fire-fanging" without using excessive amounts of water. In case the corn is frozen before it is properly matured for cutting it should be harvested at once before it has had time to dry out to any great extent. Enough water should be added to replace that lost by evaporation through standing in the field after frosting.

SORGHUM.

Sorghum is readily made into silage. The only advantages which sorghum has over corn are that it will sometimes yield heavier on poor ground and that the operation of harvesting may extend over a greater period—that is, it stays in the right stage for harvesting longer than corn. Sorghum, however, makes a poorer quality of silage, being more acid, not so palatable, and less nutritious. Where corn yields well there is no advantage in growing sorghum.

CLOVER.

Clover is a successful silage crop yielding a palatable product high in protein. It does not pack so well as corn, so great care should be exercised in the tramping of the silage at the time of filling, and the depth of the silo should also receive particular attention. A shallow silo will not prove satisfactory. Clover should be chopped before siloing as a matter of convenience in feeding and also to secure more thorough packing, although it can be placed in the silo without chopping. Clover should be harvested at the same time as for making into hay—that is, when in full bloom and some of the first heads are dead. As stated elsewhere, it is usually inadvisable to make clover into silage if it can be made into hay, as is the case under most conditions. It is better practice to grow corn for silage and use the clover in the form of hay as a supplement to the silage.

COWPEAS, ALFALFA, AND SOY BEANS.

These crops can all be successfully made into silage by exercising the same precautions as with clover. They should be cut at the same time as for haymaking. However, it is ordinarily preferable, as with clover, to make them into hay rather than silage.

Other good silage materials are kafir corn, milo maize, teosinte, and beet pulp.

HARVESTING THE CROP AND FILLING THE SILO.

HARVESTING THE CORN.

The corn is cut for the silo either by hand or by machine. Hand cutting is practiced on farms where the amount of corn to be harvested is so small as to make the expense of purchasing a corn harvester too great to justify its use. Hand cutting is also resorted to through necessity when the corn is down or lodged in such a manner as to prevent the use of the machine. This method of cutting, however, is slow and laborious and there are probably few localities now where the purchase of a harvester would not be a profitable investment. In case the expense is considered too great to be borne by a single individual two or more neighbors might well arrange to purchase a partnership machine.

In using the harvester it will be found a great advantage to make the bundles rather small. This will take more time, but the extra expense will be more than offset by the ease of handling the bundles and in feeding them into the silage cutter. Two or three horses, the latter preferable, and one man will be required to run the harvester, and they should be able to cut about 6 acres a day. The harvester should not get so far ahead of the haulers that the corn will dry out to any considerable extent. (See fig. 2.)

HAULING TO THE CUTTER.

This is ordinarily done with the common flat hay frames. An objection to their use is that it is necessary to lift the green corn fodder to a considerable height in loading, which is hard work. A low-wheeled wagon is preferable to a high-wheeled one. A low-down rack quite commonly used in some parts of the United States can be easily made. (See fig 3.) The following are the directions for making this rack, taken from Farmers' Bulletin 292:

> The rack * * * consists of two 4 by 6 inch bed pieces, 18 or 20 feet in length, bolted together at one end to form a V. On top of these timbers is built a rack 6 feet in width. The bottom of this rack is about 8 feet long. The end boards are 4 feet high, built flaring so they do not quite touch the wheels. The apex of the V is suspended below the front axle of an ordinary farm wagon by means of a long kingbolt. The other ends are attached below the hind axle by U-shaped clevises. The materials needed in its construction are 80 board feet of 4 by 6 inch plank, 96 feet of boards 1 by 12 inches, 22 feet of lumber 2 by 4 inches, 1 long kingbolt, 2 stirrup rods, and bolts and nails.

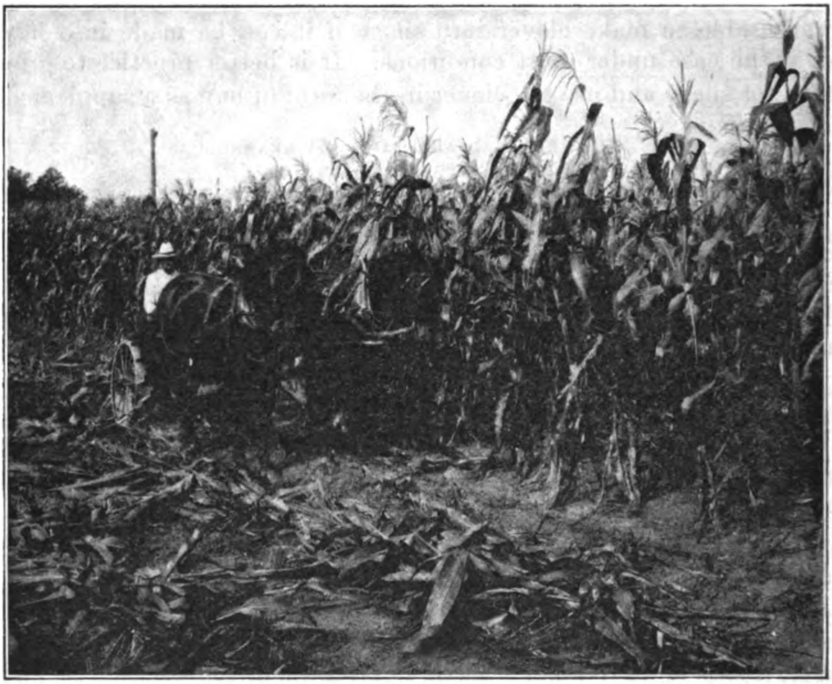

FIG. 2.—Corn harvester at work.

The load should be as large as possible, especially when the haul is for some distance. This is a matter which is rarely given sufficient attention by persons filling silos, and in consequence the expense of filling becomes unnecessarily high.

CUTTING THE SILAGE.

THE CUTTER.

There are several different makes of silage cutters on the market that will give satisfaction. The capacity of the machine to be purchased is an important consideration which should not be overlooked. Many persons make the mistake of getting a cutter which is too small, thus making the operation of filling the silo very slow and interfering with the continuous employment of the entire force of men. It is better to get a machine large enough so that every one will be able to keep busy all the time. Another matter to be considered is the fact that the larger cutters are equipped with a self-feeding device while the smaller sizes are not. Such a device saves a great deal of labor. Other factors to be taken into account in purchasing a cutter are the amount of work to be done and the power available. Of course, for the filling of a very small silo it would not be wise to buy a large machine. Neither would it be advisable to overload the engine or motor by using a cutter which is too large for the power available.

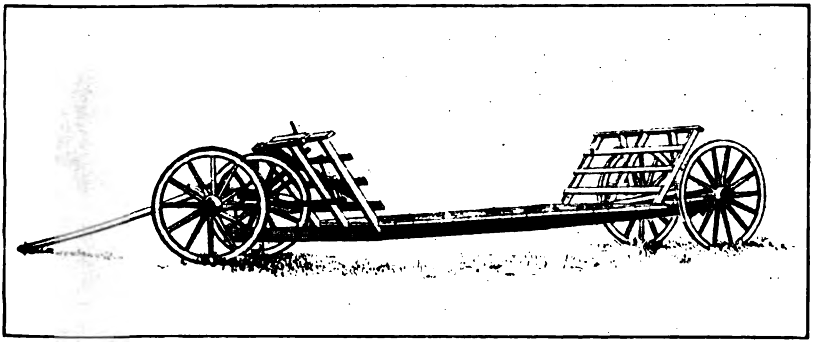

FIG. 3.—A low-down rack suitable for hauling corn to cutter.

THE ELEVATOR.

Two types of elevators are in use—the old-style chain carrier and the blower. (See fig. 4.) The chain carrier requires less power, but is harder to set up and there is more litter around when it is used, especially in windy weather. For these reasons the blower is now fast displacing the carrier.

The blower should be placed as nearly perpendicular as possible so as to reduce to the minimum the friction of the cut corn upon the inside of the pipe and reduce the danger of clogging. (See fig. 5.)

POWER REQUIRED.

The power necessary to operate the cutter will depend upon its size and whether the elevator is a chain carrier or a blower and upon the rate of feeding. It is possible to feed slowly and to get along with less power than would be required with full feeding. As a rule, however, a person should have power sufficient to run the cutter at full capacity, and even a little surplus is advisable. The power required for a cutter and blower, if a gasoline engine is used, is about 1 horsepower for each 1-inch length in the cutting cylinder; that is, a 15-inch cutter will take a 15-horsepower engine, an 18-inch cutter will require an 18-horsepower engine, and so on. If a steam engine is employed, the power should be at least two-thirds of that indicated for the gasoline engine.

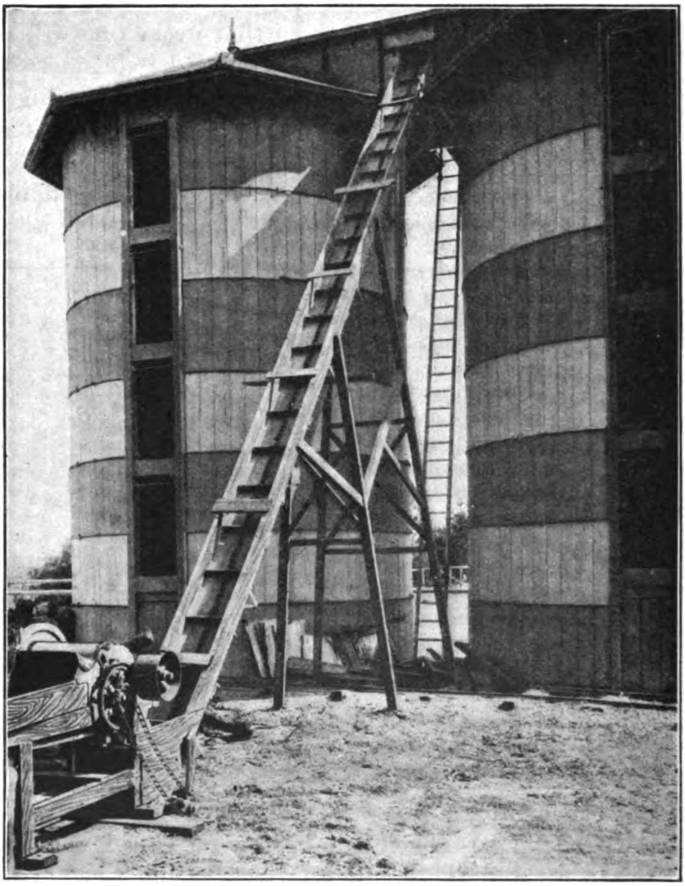

FIG. 4.—Silage cutter with chain carrier.

LENGTH TO CUT.

The usual length of cutting varies from one-half to 1 inch. The latter is considered a little too long, since pieces of this length will neither pack so closely in the silo nor be so completely consumed when fed as will the shorter lengths. On the other hand, the longer the pieces the more rapidly can the corn be run through the cutter.

PACKING THE SILAGE.

Ordinarily the blower or carrier empties the cut corn into the top of the silo and there are one or more men in the silo to distribute and tramp the material. Unless there is some one to do this the cut material will be thrown too much in one place and the leaves, stalks, and grain will not be uniformly distributed throughout the silo. The sides should be kept higher than the center and much of the tramping done close to the wall.

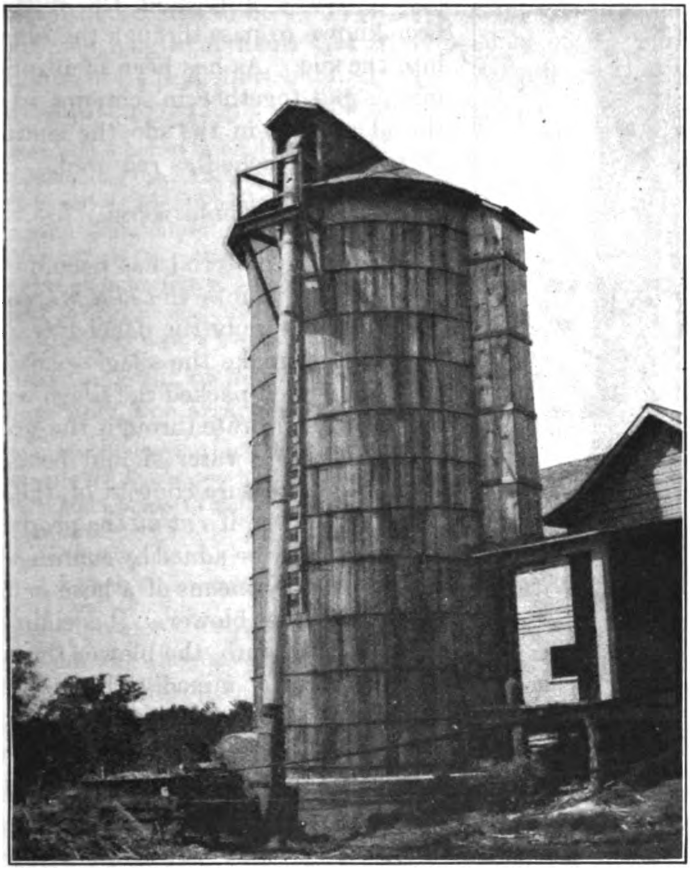

FIG. 5.—Silage cutter with blower.

Various contrivances have been used for distributing the silage. The one most to be recommended for this purpose, however, is a metal pipe similar to the one in which the cut corn is elevated, but put together loosely in sections. The corn from the blower passes down this pipe into the silo, and being loosely put together it can be swung so that the material can be placed anywhere in the silo. (See fig. 6.) With this contrivance no work with a fork is necessary and one man can do the work of two or three and do it easier. There is very little loose material flying about in the silo and the work is much cleaner. Another advantage is a lessening of the danger of being struck by some foreign object which has passed up the blower pipe. Heavy knives of the cutter have been known to pass through the blower and into the silo. As has been mentioned, this pipe is put together in sections, so that as the silage rises in the silo the sections can be readily detached as required.

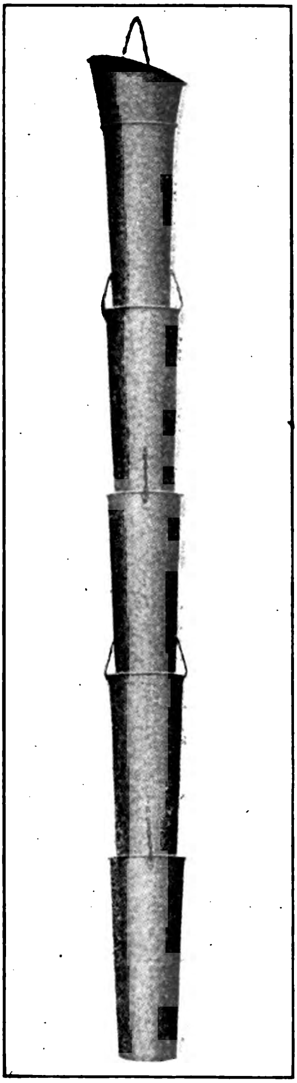

FIG. 6.—Jointed-pipe silage distributor.

ADDING WATER.

In case the material has become too dry before it is put into the silo water should be added to supply the deficiency of moisture and so make the silage pack better. Unless it is well packed the silage will "fire-fang" or deteriorate through the growth of mold. Enough water should be added to restore the moisture content of the corn to what it would be if cut at the proper stage. The water may be added by running directly into the silo by means of a hose or by running through the blower. It is claimed that by running it into the blower the water is more thoroughly mixed with the cut corn.

It seems to be good practice, no matter what the condition of the corn, to thoroughly wet down the material at the top of the silo when through filling. This will help to pack the top layer and lessen the amount of spoiled silage on top.

COVERING THE SILAGE.

Several years ago it was a common practice to cover the silage with some material, such as dirt or cut straw, in order to prevent the top layer from spoiling. At present when any provision at all is made for this purpose it consists usually in merely running in on top cornstalks from which the ears have been removed. By this method some of the corn grain is saved. The heavy green cornstalks pack much better than straw does and so exclude the air more effectually. The top is thoroughly tramped and then wet down. Sometimes oats are sown on the top before wetting. The heat generated by the fermenting mass will cause the oats to sprout quickly and form a dense sod which serves to shut off the air from the silage beneath, and in consequence only a very shallow layer spoils.

LABOR AND TEAMS REQUIRED.

The labor and teams to be used will of course depend upon the help available, the length of haul, and the efficiency of the machinery. With plenty of help, a short haul, and good machinery the following distribution of labor might well be used:

1 man and 3 horses to bind the corn.
2 men to load the corn.
3 men and 6 horses to haul.
1 man to help unload.
1 man to feed the cutter.
1 or 2 men to work in the silo.
1 man to tend the engine, if steam engine is used.
Total, 10 or 11 men, 9 horses, and 3 wagons.

The least amount of help which it would be possible to work to advantage might be arranged as follows:

1 man and 3 horses to bind the corn.
1 man to help teamsters load.
3 men and 6 horses to haul and unload.
1 man to feed.
1 man in the silo.
Total, 7 men, 9 horses, and 3 wagons.

A good manager is required to so arrange the help that each man and team can do the most efficient work. Without careful attention to this matter the operation of filling the silo becomes needlessly expensive.

COST OF HARVESTING AND FILLING.

It is not possible to set any definite figure as the cost of filling the silo because of the great variation in conditions in different parts of the country. But just in order to give some idea of the probable cost a few figures are taken from Farmers' Bulletin 292. The investigation reported in this bulletin included the work done upon 31 farms in Wisconsin and Michigan. The labor of each man was rated at 15 cents per hour and the same value placed upon each team of two horses. Engine hire was estimated at $4.50 per day, including the engineer. Twine was rated at 11½ cents a pound, coal at $5 a ton, and gasoline at 13 cents a gallon. The farmers owned their own cutters. In this investigation the cost per ton varied from 46 to 86 cents.

Investigations conducted by the Dairy Division during the past few years with 87 silos in various parts of the United States indicate the cost of filling to be an average of 87 cents per ton.

COOPERATION IN SILO FILLING.

The high cost of silo-filling machinery makes it oftentimes advisable for several farmers to cooperate in the purchase of a cutter and engine, or at least a cutter, since an engine is easier rented than a cutter. By varying the time of planting in the spring each man can get his silo filled when the corn is at the proper stage of maturity. Besides this the farmers can help one another in filling, so that there need be a very small cash outlay.

TOTAL COST OF SILAGE.

As with the cost of filling the silo, no definite figure can be set as to the cost of silage. This will depend upon the yield per acre, the cost of growing an acre, and the cost of filling. Several years ago the cost was variously estimated at from $1 to $1.50 per ton. At present this is much too low. The before-mentioned data collected by the Dairy Division on the filling of 87 silos in various parts of the country show the cost of growing the silage crop to average $1.58 per ton. This added to the 87 cents, which represents the cost of filling, makes the total cost of the silage $2.45 per ton. The cost of the silage for the individual farms varied from $1.10 to $5.42 per ton. In general, it may be stated that $1.50 to $3.50 per ton represents the limits between which most of the silage is produced.

LOSSES OF FOOD MATERIAL IN THE SILO.

When any crop is made into silage certain fermentation takes place, which results in the production of a considerable amount of heat and the consequent loss of food material. The extent of this fermentation is dependent upon the amount of air in the silo. The more air there is present the higher will be the temperature of fermentation and the greater the loss of food ingredients. Fermentation will continue until all the oxygen of the air has been used up or has been displaced by carbon dioxid. In the deep silos of the present time the pressure is so great that very little air is left in the silo, consequently the losses of food ingredients are reduced to a minimum. As before mentioned, on account of the difficulty of pressing out this air in crops with hollow stems they are seldom put in the silo.

There have been some experiments conducted at the Wisconsin station which show that the losses in the siloing of corn are not nearly so great as in the field curing of corn fodder. According to Prof. Woll, in modern, well-built, deep silos the loss should not exceed 10 per cent. More food material can be saved by putting the corn crop in the silo than by harvesting and storing it in any other way.

FEEDING VALUE OF SILAGE.

COMPOSITION.

The composition of silage will, of course, vary according to the crop from which it is made, the degree of maturity of the crop, and other factors. The following figures, taken from Henry's Feeds and Feeding, represent the digestible nutrients in 100 pounds of average silage:

Crop.	Total dry matter.	Digestible.		
		Protein.	Carbohydrates.	Fat.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Corn	26.4	1.4	14.2	0.7
Sorghum	23.9	.1	13.5	.2
Red clover	28.0	1.5	9.2	.5
Soy bean	25.8	2.7	9.6	1.3
Cowpeas	20.7	1.5	8.6	.9

It will be observed that about three-fourths of the total weight of silage consists of water. It will also be noticed that both corn and sorghum contain a large amount of carbohydrates in proportion to the protein. Silage is a bulky, succulent feed with a wide nutritive ratio, and for these reasons it will give the best results when fed along with some other feed richer in dry matter and in protein.

SUCCULENCE.

It is quite important in the feeding of cattle that the ration include some succulent material such as fresh grass, root crops, or silage. A feed containing a large amount of natural water is not only more easily digested but is also more palatable and, besides, serves the useful purpose of keeping the whole system of the animal in a state of healthy activity. A silage-fed animal is rarely troubled with constipation or other digestive disturbances, the coat is noticeably sleek and soft, and the skin is soft and pliable. It is a well-known fact that a cow usually reaches her maximum production when she has access to a good pasture. The cheapest and best substitute for fresh pasture grass during the fall and winter is silage.

PALATABILITY.

No rough feed is more palatable than good corn silage. Sometimes, however, a cow will not eat silage readily until she has acquired a taste for it, which may require several days. But silage is not peculiar in this respect, for it has been observed that range horses or cattle shipped into the corn belt will refuse corn the first time it is offered to them. This quality of being palatable is a decided advantage for silage in that it induces a large consumption and promotes the secretion of digestive juices.

RELATIVE FEEDING VALUE.

The value of silage as a food may be best shown by comparing it with other feeds. The most accurate comparison which is available is found in Farmers' Bulletin 346. The figures given below are taken from this bulletin.

Energy value of various feeds in therms per 100 pounds of the feed.

Corn silage	16.56	Oats	66.27
Red clover hay	34.74	Linseed meal	78.92
Timothy hay	33.56	Cottonseed meal	84.20
Mangel-wurzels	4.62	Wheat bran	48.23
Corn	88.84		

These figures were obtained through experimentation with beef animals and are not claimed to be other than tentative and subject to correction later on. While they have not been prepared as a result of work with any kind of animals other than those for beef, it is thought that they are approximately correct when applied to sheep, horses, and dairy cows. At any rate they are the most reliable figures which we have at present.

From the table given it will be observed that clover hay is a little more than twice as valuable, pound for pound, as silage, that bran is three times as valuable, and that corn is more than five times as valuable. In other words, the feeding values of silage, clover hay, bran, and corn are in the approximate ratio of silage 1, clover hay 2, bran 3, and corn 5.

SILAGE FOR DAIRY CATTLE.

Silage has been found to be particularly well adapted to the dairy cow and as a consequence silos are more numerous upon farms devoted to dairying than upon any other kind of farms. In many sections silage has come to be the dairy farmer's main reliance for cow feed.

SUPPLEMENTARY FEEDS.

While silage is an excellent feed it is not a complete one for dairy stock. It is too bulky and watery and contains insufficient protein and mineral matter to fully meet the requirements of the dairy cow. It should be combined with some leguminous hay such as clover, cowpeas, or alfalfa. These will tend to correct the deficiencies of the silage in dry matter, protein, and mineral constituents. A ration of silage and, say, alfalfa hay alone is satisfactory, however, only for cows which are dry or giving only a small amount of milk and for heifers and bulls. Cows in full milk require some more concentrated feed than hay or silage, else they can not consume enough feed to meet the demands of the body. The result will be that the cows lose in flesh and in milk flow.

AMOUNT TO FEED.

The amount of silage to feed a cow will depend upon the capacity of the animal to take feed. She should be fed as much as she will clean up without waste when consumed along with her hay and grain. Raise or lower the amount until the proper quantity is ascertained. Generally speaking, a good cow should be fed just short of the limit of her appetite. If she refuses any of her feed it should be reduced at once. The small breeds will take 25 or 30 pounds per day; the large breeds about 40; and the medium-sized ones amounts varying between.

RATIONS.

Ironclad directions for feeding cows can not be given. In general, however, they should be supplied with all the roughage they will clean up with grain in proportion to butterfat produced. The hay will ordinarily range between 5 and 12 pounds per cow per day when fed in connection with silage. For Holsteins 1 pound of concentrates for each 4 pounds of milk produced will prove about right. For Jerseys 1 pound for each 3 pounds of milk or less will come nearer meeting the requirements. The grain for other breeds will vary between these two according to the quality of milk produced. A good rule is to feed seven times as much grain as there is butterfat produced.

The following rations will be found good:

For a 1,300-pound cow yielding 40 pounds of milk testing 3.5 per cent:

	Pounds.
Silage	40
Clover, cowpea, or alfalfa hay	10
Grain mixture	10

For the same cow yielding 20 pounds of 3.5 per cent milk:

Silage	40
Clover, cowpea, or alfalfa hay	5
Grain mixture	5

For a 900-pound cow yielding 30 pounds of 5 per cent milk:

Silage	30
Clover, cowpea, or alfalfa hay	10
Grain mixture	11

For the same cow yielding 15 pounds of 5 per cent milk:

Silage	30
Clover, cowpea, or alfalfa hay	8
Grain mixture	5

A good grain mixture to be used in a ration which includes silage and some sort of leguminous hay is composed of

	Parts.
Corn chop	4
Wheat bran	2
Linseed-oil meal or cottonseed meal	1

In case the hay used is not of this kind some of the corn chop may be replaced by linseed or cottonseed meal. In many instances dried brewers' grains or crushed oats may be profitably substituted for the bran.

TIME TO FEED.

The time to feed silage is directly after milking or at least several hours before milking. If fed immediately before milking the silage odors may pass through the cow's body into the milk. Besides, the milk may receive some taints directly from the stable air. On the other hand, if feeding is done subsequent to milking the volatile silage odors will have been thrown off before the next milking hour. Silage is usually fed twice a day.

Many objections have been made to the feeding of silage; some condenseries even refusing to let their patrons use it. These objections are becoming less common, since milk from cows fed silage in a proper manner is in no way impaired; besides which there is nothing about silage that will injure in any way the health of the animals.

FEEDING FROZEN SILAGE.

Frozen silage must first be thawed before feeding. If it is then given immediately to the cows before decomposition sets in no harm will result from feeding this kind of silage; neither is the nutritive value known to be changed in any way.

SILAGE FOR CALVES, BULLS, AND DRY COWS.

Calves may be fed silage with safety when they are about 3 or 4 months old. It is perhaps of greater importance that the silage be free from mold or decay when given to calves than when given to mature stock. After the calves are weaned they may be given all the silage they will eat up clean. Yearling calves will consume about one-half as much as mature stock, that is, from 15 to 20 pounds a day. When supplemented with some good leguminous hay little, if any, grain will be required to keep the calves in a thrifty, growing condition.

There is a decided opinion among some breeders of dairy stock that a large allowance of silage is detrimental to the breeding qualities of the bull. Whether there is any scientific foundation for this opinion remains to be determined. Pending further investigations, however, it is advisable to limit the allowance to about 15 pounds of silage a day for each 1,000 pounds of live weight. When fed in this amount silage is thought to be a good, cheap, and safe feed for bulls. It should of course be supplemented with hay, and with a small allowance of grain also in the case of bulls doing active service or growing rapidly.

Cows when dry will consume almost as much roughage as when milking. Silage may well form the principal ingredient of the ration, in fact, with 25 to 40 pounds of silage and a small supplementary feed of clover, cowpea, or alfalfa hay, say 5 or 6 pounds a day, the cows will keep in good flesh and even make some gain. Cows in thin flesh should receive in addition a small amount of grain. Silage will tend to keep the whole system in a state of healthy activity and in this way lessen the troubles incident to parturition.

SILAGE FOR SUMMER FEEDING.

One of the most trying seasons of the year for the dairy cow is the latter part of summer and early fall. At this season the pastures are often short or dried up, and in such cases it is a common mistake of dairymen to let their cows drop off in flow of milk through lack of feed. Later they find it impossible to restore the milk flow no matter how the cows are fed. Good dairy practice demands that the milk flow be maintained at a high point all the time from parturition to drying off. It becomes necessary, therefore, to supply some feed to take the place of the grass. The easiest way to do this is by means of silage. Silage is cheaper and decidedly more convenient to use than soiling crops.

The amounts to feed will depend upon the condition of the pastures, varying all the way from 10 pounds to a full winter feed of 40 pounds. It should be remembered in this connection that silage contains a low percentage of protein, so that the greater the amount of silage fed the greater must be the amount of protein in the supplementary feeds to properly balance the ration.

SILAGE FOR HORSES.

By George M. Rommel, *Chief of the Animal Husbandry Division.*

Silage has not been generally fed to horses, partly on account of a certain amount of danger which attends its use for this purpose, but still more, perhaps, on account of prejudice. In many cases horses have been killed by eating moldy silage, and the careless person who fed it at once blamed the silage itself, rather than his own carelessness and the mold which really was the cause of the trouble. Horses are peculiarly susceptible to the effects of molds, and under certain conditions certain molds grow on silage which are deadly poisons to both horses and mules. Molds must have air to grow and therefore silage which is packed air-tight and fed out rapidly will not become moldy. If the feeder watches the silage carefully as the weather warms up he can soon detect the presence of mold. When mold appears, feeding to horses or mules should stop immediately.

It is also unsafe to feed horses frozen silage on account of the danger of colic. This is practically impossible to avoid in very cold weather, especially in solid-wall silos. By taking the day's feed from the unfrozen center of the silo and chopping away the frozen silage from the edges and piling the frozen pieces in the center the mass will usually thaw out in time for the next feed.

Corn to be made into silage for horses should not be cut too green, as sour silage will result and may cause colic when fed. The corn should be well matured and cut when the grain is beginning to glaze. The silo should be filled rapidly and the corn should be vigorously tramped and packed while filling. At least three men should be inside the silo, moving constantly, two around the edges and the third across and around the center. This is by far the most important point in connection with feeding silage to horses, and the lives of the horses fed on silage may depend on the thoroughness with which the tramping is done. If properly done no danger is likely to result; if not properly done air pockets may form and cause the accumulation of a small mass of mold which the feeder may overlook but which might be sufficient to kill one or more horses.

The value of silage for horses is greatest as a means to carry them through the winter season cheaply or to supplement pasture during drought. As the danger of mold is greater in summer than in winter, silage should not be fed to horses in that season unless a large number of animals are getting it and the daily consumption is so large as to preclude the formation of mold on the surface.

To cheapen the ration of brood mares in winter no feed has more value than good corn silage. If the grain goes into the silo with the stover no additional grain is needed for brood mares, hay being the only supplementary feed necessary. If there is little grain on the corn the silage should be supplemented with 1 pound of old-process linseed-oil meal or cottonseed meal daily per 1,000 pounds live weight, sprinkled over the silage.

Horses to be wintered on a silage and hay ration should be started on about 5 pounds of silage daily per 1,000 pounds live weight, the grain and hay ration being gradually decreased as the silage is increased until the ration is 20 pounds silage and 10 pounds of hay daily per 1,000 pounds live weight. It will require about a month to reach the full feed of silage, but the period may be decreased somewhat, depending on the judgment and skill of the feeder.

Mares fed in this manner will be in splendid condition for foaling, and, so far as the writer's experience goes, the foals will be fully as vigorous, with just as much size and bone, as if the mares were fed the conventional grain and hay ration.

Work horses when idle can be wintered satisfactorily in this manner, but much silage is not recommended for horses at heavy work for the same reason that a driving horse can not do his best while on watery grass pasture.

The writer knows of cases where stallions receive a ration of silage, but has had no experience in feeding them in this manner. There seems no reason why silage should not be a valuable feed for stallions during the idle season.

Silage should also be useful for young horses, especially drafters, but here again the writer can not quote his own experience and experimental data are meager.

To summarize, silage is safe to feed to horses and mules only when it is made from fairly mature corn, properly stored in the silo. When it is properly stored and is not allowed to mold, no feed exceeds it as a cheap winter ration. It is most valuable for horses and mules which are not at heavy work, such as brood mares and work horses during the slack season. With plenty of grain on the cornstalks, horses will keep in good condition on a ration of 20 pounds of silage and 10 pounds of hay for each 1,000 pounds of live weight.

SILAGE FOR BEEF CATTLE.

By W. F. Ward, *Animal Husbandman in Beef Cattle Investigations.*

There is no roughage which is of more importance to the producer of beef cattle than silage. The value of silage to the beef producer varies considerably and is dependent upon a large number of other factors. If rough fodders are scarce or are high priced, if the grain is high priced, or if the grain is so near a good market that much of it can be readily sold, silage will have a greater value than if the opposite conditions exist. It is a great saver of grain regardless of whether it is to be fed to stock cattle or fattening cattle. It will lessen the grain feeding by practically the same amount as is contained in the silage. The value will also depend somewhat upon the kind of cattle to which it is to be fed. If there is an abundance of rough fodders which can not be marketed, silage will not be so valuable. But in a case of this kind the silage would prove more valuable if used for the calves and pregnant cows and the coarse fodders used for the other stock.

SILAGE FOR THE BREEDING HERD.

For wintering the entire breeding herd there is no roughage better than silage. All of the animals will relish a ration containing it and it will create a good appetite for all other feeds. Cows that are fed all of the silage they will consume along with clover hay will go through the winter in fine shape and make small gains. If the amount of silage is limited, a more economical method of wintering them will be to reduce the silage to a half ration, letting them have the run of a straw stack and feeding about 2 pounds of cottonseed meal or oil meal per day. Some dry coarse fodder or straw should always be kept before animals getting silage, as it reduces the amount of silage consumed and prevents the bowels from becoming too loose. The succulent feed will cause the breeding cows to give a good flow of milk even though the calf be born in midwinter, and a thrifty calf will result. If the silage is free from mold or rotten spots there will be no danger in feeding it to breeding cows.

Silage is especially beneficial for calves which have just been weaned. They take to this ration quicker than to dry feed and there is usually little loss in weight from the weaning. The silage should be supplemented with some good leguminous hay, as alfalfa, cowpea, or clover, and the calves should be given a small amount of grain. A mixture of one-half corn chop and one-half cottonseed meal is excellent.

SILAGE FOR STOCKERS.

Each farmer will have to plan the rations for his cattle according to the amount of the various feeds he has on hand. Stockers can be wintered on silage and some good hay, fodder, or straw, but this may not always be the most profitable. When hay is high priced and grain is reasonably cheap or plenty of silage is available, it may be more economical to omit the hay altogether. A ration of corn silage alone has often been profitable for thin cattle. Stockers which have been fed liberally all winter and made to put on good gains usually do not make as large daily gains when put on grass as do steers which have not been quite so well fed. The time the cattle are to be finished for market and the degree of fatness to be attained should govern to a large extent the method to be followed during the winter. When beeves are expected to sell high in the early summer and the steers are to be finished for market at that time, a heavy roughage ration with a small amount of grain should be fed during the winter months.

SILAGE FOR FATTENING ANIMALS.

Silage stands first in rank of all the roughages for finishing cattle. Formerly, during the era of cheap corn and other concentrates little attention was given to the roughage, as it was usually considered merely a "filler" and of very little economic value in feeding. No especial care was taken in selecting any particular kind, nor was the quality of it seriously considered. As the prices of the concentrated feedstuffs advanced, the feeder looked about for methods of cheapening the cost of producing beef and soon found this could be accomplished by using judgment in selecting his roughage with respect to the grain fed. This has continued until at the present time the roughage receives as much attention as the concentrated feed, and has been made to take the place of a large amount of the latter. The feeding of silage came into general use with the advent of expensive grain and is becoming more popular each year. With the present prices of feedstuffs there is hardly a ration used for feeding cattle which can not be cheapened by the use of this succulent feed. By combining it with other feeds the efficiency of the ration is increased to such an extent that the amount of the daily gains is invariably greater and the cost of producing a pound of gain is lessened. The heaviest daily gains are usually made during the first stage of the feeding period, and silage can then be used to advantage in large quantities with a small amount of grain, but as the feeding progresses the amount of silage should be lessened and the grain increased. In some places the price of hay and stover is so high that the greater the proportion of silage used in the ration the more profitable is the feeding.

Conditions in general are such that any given ration will not suit a large number of farmers, nor will it be so profitable for some as it will for others, so each farmer must determine for himself just what combination of feeds will be most profitable for his use. However, to give a general idea of some of the rations adapted to different localities and which may prove satisfactory for a 1,000-pound steer, some examples are given below:

RATIONS.

FOR THE CORN BELT.

		Pounds.
(*a*)	Corn silage	25
	Corn stover	6
	Cottonseed meal or oil meal	3
	Shelled corn	14
(*b*)	Corn silage	25
	Clover hay	7
	Shelled corn	15

FOR THE EASTERN STATES WHERE HAY IS VERY HIGH AND CORN IS RELATIVELY HIGH.

	Pounds.
Corn silage	30
Corn stover	6
Cottonseed meal or oil meal	4
Shelled corn	10

FOR THE SOUTH WHERE COTTONSEED MEAL IS OF MODERATE PRICE AND COWPEA HAY IS RAISED ON THE FARM.

		Pounds.
(*a*)	Corn silage	35
	Cowpea hay	8
	Cottonseed meal or oil meal	7
(*b*)	Corn silage	30
	Cottonseed hulls	12
	Cottonseed meal	7

FOR THE WEST WHERE CORN CAN NOT BE RAISED.

		Pounds.
(*a*)	Kafir-corn silage	30
	Prairie hay	3
	Cottonseed meal	3
	Kafir-corn meal	10
(*b*)	Kafir-corn silage	25
	Alfalfa	7
	Kafir corn	15

It should be understood that the above rations are not necessarily to be fed in the exact quantities given above, but should be modified to suit local conditions or the actual conditions on each farm. They are given to show approximately the average amounts and character of feed that would be consumed daily by a 1,000-pound steer during the feeding period.

It is well to feed as near a balanced ration as possible without materially increasing its cost. Sometimes the prices of available feeds are such that a farmer is justified in deviating from the standard. Such conditions are illustrated by the use of some of the rations given above. The second ration shown for the South is an example, as that ration is very narrow, but in certain localities it is more profitable than one which is balanced by the use of high-priced carbohydrate feeds.

Two rations are shown for the West where kafir-corn silage is used. With some farmers it would undoubtedly be more profitable to use alfalfa hay as a substitute for cottonseed meal, while with others the purchase of the cottonseed meal would be more economical.

MISCELLANEOUS CONSIDERATIONS.

Silage is a quick finishing roughage in that it produces large daily gains and produces a glossy coat and a soft, pliable skin. Moreover, it can be used to advantage at times for carrying cattle for a longer time so as to pass over a period of depression in the market, or to carry the cattle along in thrifty condition so they can be finished at a later period.

For many years the belief was general that cattle which received silage as a major portion of the roughage would have to be kept in warm barns and not be exposed to the cold. While they do need protection from the cold winds and rains and need a dry place to lie down, it has been clearly demonstrated that warm barns are not only unnecessary but that fattened cattle make both larger and cheaper gains when fed in the open sheds than when confined in barns. Stocker or thin cattle receiving silage will of course need more protection than animals which are being fattened.

Silage can be profitably used to supplement the pastures for steers during a time of drought, when they are being finished for market, but it is still an open question whether it can always be used profitably for feeding to breeding cattle during such times.

The theory that silage-fed cattle shrink very heavily in shipping to market is erroneous. While the actual shrinkage during transit is sometimes greater, the fill taken at market is usually good, and if good judgment is used in preparing them for shipping the net shrinkage is no greater than for cattle which have been fed on dry feeds. For 36 hours previous to shipping nice bright hay and stover should be substituted for the silage in the ration.

The general impression that choice or prime carcasses can not be made by the use of succulent feed is equally untrue, as the silage-fed cattle usually make more desirable carcasses than cattle fed a similar ration, except that silage was replaced by one of the coarse fodders. There is no appreciable difference in the percentage of marketable meat that steers will dress out which have been finished on a silage ration and a dry ration. The meat seems equally bright and the fat as well intermixed with the lean.

If silage makes up the bulk of the roughage it will be necessary to haul large amounts of bedding into the sheds to keep the animals dry, as there is no waste in silage, or else make a cement floor and cover with bedding to absorb the urine and prevent the animals from slipping and to give them a warm place to lie down. When the enormous saving in the quality and amount of the feed is considered, this disadvantage does not seem so hard to overcome by the stockman who has the capital to put up the silo and pave his feed sheds or feed lots.

SILAGE FOR SHEEP.

By E. L. Shaw, *Animal Husbandman in Sheep and Goat Investigations.*

The use of this succulent feed for sheep has attracted the attention of most farmers only during the past few years. Although a few sheepmen fed silage many years ago with good results, most flockmasters have been slow in giving it a trial. Owing to the wonderful increase in the use of silos on farms, and owing to the cheapness of silage as compared with other succulent feeds, such as roots, farmers are constantly raising the question regarding the feeding of silage to sheep. A great deal has been said of its bad effects upon sheep, but these have arisen either because an inferior quality of silage was fed or on account of carelessness on the part of the feeder in not feeding it properly.

A good quality of silage is extremely palatable and can be fed to all classes of sheep with good results. It must be borne in mind, however, that silage which is either very sour, moldy, or frozen should not be fed.

The amount of silage reported in feeding trials varies from 1 to 5 pounds per head per day. The amount to feed depends upon the class of sheep and the character of the other feeds comprising the ration. As a general rule from 2 to 4 pounds per head per day is considered as much as should be fed.

Lamb feeders have found silage a very satisfactory feed, and the amount fed ranges from 1 to 3 pounds per day. Where lambs are on full feed of grain, such as corn, and are receiving a fair allowance of hay, they will, as a rule, only consume from 1 to 2 pounds per head per day.

In feeding breeding ewes before lambing a daily allowance of from 2 to 3 pounds should be considered a maximum quantity. After lambing the amount can be slightly increased.

In feeding silage or any other succulent feeds it must be borne in mind that the value of such feeds to a large extent is to act as an appetizer and to keep the digestive system in good condition. Under ordinary conditions where silage is fed it should not constitute more than one-half of the entire ration, and it should be fed with other feeds that will properly balance the ration for the purpose intended.

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THE POTATO-TUBER MOTH.[1]

By F. H. Chittenden, Sc. D.,
In Charge of Truck Crop and Stored Product Insect Investigations.

INTRODUCTORY.

For many years the potato-tuber moth, known scientifically as *Phthorimæa operculella* Zell., has been the worst potato pest in California. It has now reached the State of Washington and southern Texas and menaces adjacent States. This insect feeds also upon tomato, eggplant, and tobacco, which do not, however, as a rule, suffer much injury. When it occurs on tobacco it is known as the splitworm.

The mature moth of this species, which is quite small and grayish in color, is shown in figure 1, *a;* the larva is shown in *b* and *c;* and the pupa in *d*. Sizes are indicated by the size lines in the figure.

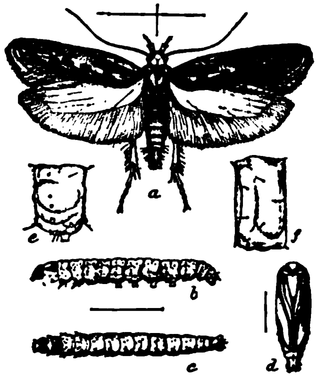

Fig. 1.—The potato-tuber moth (*Phthorimæa operculella*): *a*, Moth; *b*, larva, lateral view; *c*, larva, dorsal view; *d*, pupa; *e*, *f*, segments of larva, enlarged. (Redrawn from Riley and Howard.)

The eggs may be laid upon the leaves or on other parts of the plants, and the minute caterpillars or worms quickly bore between the surfaces of the leaves or into the potato skin, which they mine in every direction, finally devouring the exterior. It is believed that there are two or more generations in the course of a summer, and certainly another one can be produced in store. It thus happens that this insect belongs to both truck-crop and stored-product insect pests.

An example of injury by this species to potatoes is shown in figure 2. At *a* is a section showing the eggs; at the left is a section of a badly infested potato containing two pits, *d* and *f*, in which the larva has been at work, while at *b* and *c* is shown the egg, highly magnified. Figure 3 gives an exterior view of a potato which has been destroyed by the tuber moth.

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[1] The account here given is issued with the purpose of warning potato growers and giving general information in regard to remedies. Work was begun on this species in 1912 and will continue. This is a revised and amplified account, first published as Circular 162 of the Bureau of Entomology.

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DISTRIBUTION.

This species is widespread in its distribution, but in this country, until the year 1912, we did not know of its rapid dissemination. Abroad it is well known in Hawaii, all portions of Australia, New Zealand, Algeria, the West Indies, Peru, and many other countries, including southern Europe. As an enemy to tobacco it has been known for several years in Florida, and in North Carolina, South Carolina, and Virginia.

The species occurs in southern California practically wherever potatoes are grown commercially, extending its range northward to the Sacramento Valley.

As an enemy to eggplant and ground cherry it has been observed as far north as the District of Columbia.

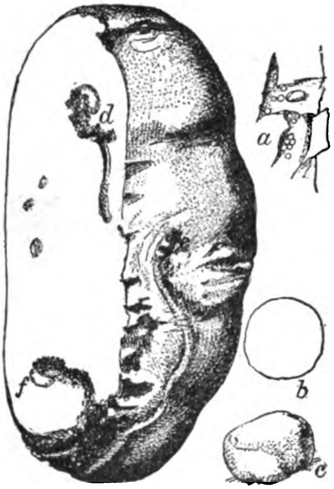

FIG. 2.—Work of the potato-tuber moth: *a*, Section of tuber, showing eye and eggs deposited about it; *b*, egg in outline; *c*, egg, lateral view; *d*, *f*, mines of larva in potato. *a*, Natural size; *b*, *c*, greatly enlarged; *d*, somewhat reduced. (Redrawn from Riley and Howard.)

The directions for applying remedies which follow are for the benefit of persons inquiring in regard to means of control. Which of these should be used can be best determined by trial in the different localities under the different conditions in which the insect exists. This applies especially to the question as to the best material for fumigation.

EVIDENCE OF IMPORTANCE.

As evidence of the importance of the pest Mr. J. E. Graf, working under the direction of the writer, wrote:

> In September, 1912, an unusual outbreak of this pest occurred at El Monte, Cal., due entirely to a combination of circumstances. Thousands of acres of potatoes were planted in southern California—many more than the market would stand. This meant that the market was continually clogged and the prices were poor, so that the crop was worked off very slowly. The tuber moth (*Phthorimæa operculella*) is always found here, but the crop is generally handled so quickly and carefully that small loss results. This year, however, careless work and the leaving of potatoes in the ground too long have given the insect a tremendous start, and now its ravages are greater than ever before. A combination of the moth and low prices has so discouraged many of the growers that they are leaving their potatoes to rot, and as these are becoming infested there will be a great number of moths waiting for the fall potatoes. * * *

Later, September 17, 1912, Mr. Graf wrote in regard to injury by this species that two growers near El Monte, Cal., lost $90,000 and $70,000, respectively, on potatoes that year. Items of this kind show the necessity of investigating the problem.

Aside from numerous similar complaints, including the usual number from California for the past two years, this species has been received from Eagle Lake and Hallettsville, Tex.; San Jose, Costa Rica; Seattle, Auburn, and Yakima, Wash.; New York City, where it has not become acclimatized so far as known; Fort Collins, Colo.; and Larimore, N. Dak. These records include only occurrences on potato.

In the case of the last report the tuber moth was stated to have been imported into southern California in potatoes from China. It is doubtful if the species has been established in North Dakota, but inquiries have been made in regard to the danger of its being introduced there as well as into Minnesota and many other States.

REMEDIES.

The potato-tuber moth is a difficult insect to control by any single method. It is not possible to reach the tuber worms in their mines in the potatoes or in the stalks or tubers while growing in the field, which makes it necessary to proceed against the pest by other methods. Of these, several must be employed to insure success.

CLEAN METHODS OF CULTIVATION.

The first measure consists in the maintenance of clean methods of cultivation. This implies that all infested potato plants and solanaceous weeds, such as ground cherry, bull nettles, horse nettles, and volunteer potato plants, growing in the same vicinity as the potatoes, must be destroyed. This can be done by prompt burning as soon as insect infestation is manifest. The burning of these weeds will eliminate places for the breeding of the insect or for its successful hibernation. Domestic animals, such as sheep and hogs, are valuable for the destruction of remnants and may be utilized by merely turning them into the field.

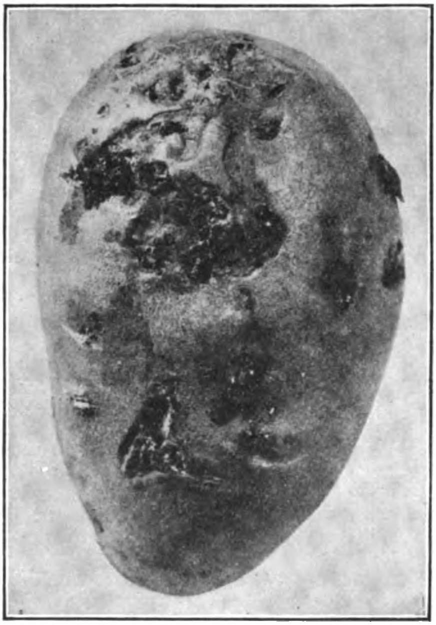

FIG. 3.—Work of the potato-tuber moth. Exterior view of potato. (Original.)

CROP ROTATION.

As in most other cases of insect injury, crop rotation is desirable where possible, and the cooperation of all potato growers of the neighborhood is practically a necessity. In certain cases, as, for example, in a county where many potatoes are grown, it might be possible by legislation to enforce the discontinuance of potato planting for a year, requiring at the same time the destruction of the weeds which serve as food plants. There are several alternate food crops which do not suffer materially from this insect. About the best of these are leguminous crops, like beans, peas, cowpeas, alfalfa, and clover. These possess a dual value, as they all act as soil restorers. Sugar beets, celery, and crucifers are also good as alternate food crops. Grains may serve in the same way, as they are not attacked by the tuber moth.

Care in digging is advisable in order not to cut into the tuber or leave the dug potatoes in the field over night where reinfestation could occur.

FUMIGATION.

While all of these remedies are of value, the best remedy is the fumigation of infested tubers with bisulphid of carbon or hydrocyanic-acid gas. If bisulphid of carbon is used, it should be at the rate of 3 pounds to 1,000 cubic feet of air space, including the potatoes; 1 ounce to a barrel of 96 pounds' capacity would not be excessive. With an exposure of not more than 24 hours no harm should be done to the potatoes for planting. The bisulphid should be evaporated in tins, like pie plates or pie pans, and a cover should be placed on the top of the fumigating barrel or box so as to make it as nearly air-tight as possible. At the end of 24 hours the potatoes should be removed, placed in a fresh barrel, and closed up.

Where it can be conveniently done, hydrocyanic-acid gas should be used in a specially constructed fumigator (see fig. 4), also gas-tight. *In the case of bisulphid of carbon there is great danger in bringing the chemical into proximity to fire, such as a lighted lantern or cigar, for the gas is highly inflammable and even explosive.* Then, too, the bisulphid-of-carbon method costs slightly more than the hydrocyanic-acid-gas method.

Fumigation with hydrocyanic-acid gas, properly performed, is not dangerous, but if improperly performed it is decidedly dangerous to human and other animal life, as the fumes are very poisonous and are *deadly* when inhaled in any amount. This gas is more penetrating than bisulphid of carbon and can be used by an intelligent person without trouble, if he first familiarizes himself thoroughly with the procedure by carefully studying the printed directions or assisting some one who has had experience in this work. The cubic contents of the receptacle to be fumigated, on which is based the amount of chemicals to be used, can be readily computed.

The fumigating box shown in the illustration, which will presently be described, may merely be taken as an example of what can be easily constructed to meet the purpose. In the case of this box the potatoes are best fumigated in bags, which can be piled one on top of another. If bins or other fumigators are used, the proportions will vary. They can be constructed longer or shorter and lower, according to the individual needs and desires of the potato grower.

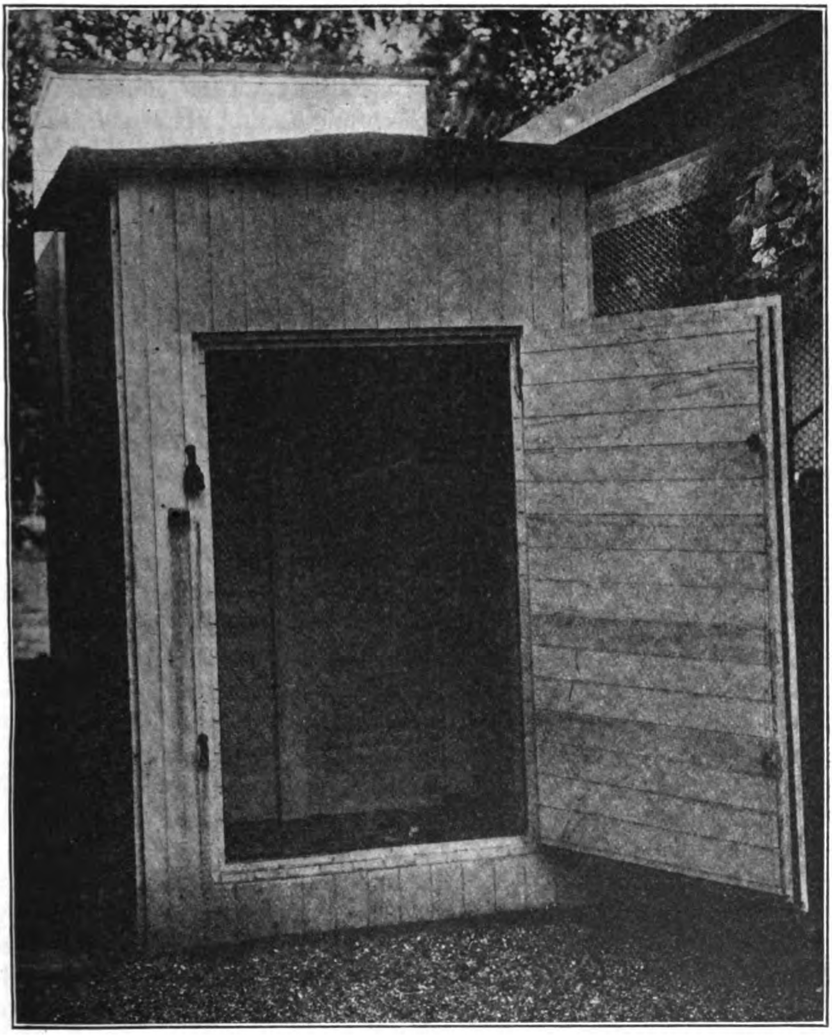

FIG. 4.—Fumigator used for stored products infested by insects. (Author's illustration.)

THE CONSTRUCTION OF A FUMIGATOR.

A building, box, or room (see fig. 4) of about 100 to 200 bushels capacity suitable for the fumigation of a quantity of potatoes would contain about 500 cubic feet. A fumigator of this cubic capacity might be built 8 feet square by 8 feet in height. A good, and perhaps the best, means of preventing the escape of the gas is to line the fumigator with sheet tin, with soldered joints, and over sheathing. Another method is to sheath the room inside, cover the walls, ceiling, and floor with tarred or heavy building paper, with joints well lapped, and cover the inside with matched ceiling boards. The fumigator should always be equipped with a tight door in which the joints have been broken, similar to the door of a refrigerator or safe, and should close with two refrigerator catches against a thick felt weather strip, which should render it practically gas-tight. Thus constructed it would furnish sufficient space for the fumigation of about 200 bushels of material. There would also be sufficient space for the application and diffusion of the carbon bisulphid, hydrocyanic-acid gas, or other fumigant from the top with a charge more than necessary for the quantity of potatoes treated.

It sometimes happens that the price of potatoes is so low that the small grower can not well afford to expend the amount of money which would be necessary for the construction of a special fumigator. In such a case it would be advisable to use a barrel, preferably a large oil barrel, with a tight-fitting cover for fumigating. It is possible also to fumigate, but not thoroughly, piles of tubers by covering them as tightly as possible with canvas, such as 10-ounce duck or tarpaulin.

PROTECTION OF THE FALL CROP AND SEED POTATOES.

A special letter of warning against the ravages of the potato-tuber moth in the shape of a press notice has been sent broadcast to newspapers, as well as to others, throughout the country. The main facts in the case were founded on the experience of Mr. Graf in his investigations and in his dealings with the potato growers of southern California. Concisely stated, the warning is to enable potato growers to undertake special work with seed potatoes and with the fall crop.

For the protection of potatoes in fall against this pest it is urged that potato growers sort the potatoes for seed two weeks after digging and again two weeks later. The uninfested tubers should then be placed in a moth-proof bin. The infested tubers may be readily picked out because of the excrement of the larvæ which adheres by webbing to the outer skin of the potatoes. The tubers in the moth-proof bin, after final sorting, should be fumigated with carbon bisulphid (bisulphid of carbon) to destroy any moths which might have bred out or have obtained entrance through other means. Growers should now keep a careful lookout both in the field and among the fumigated tubers. At first those which have been fumigated should be inspected daily. Afterwards observations may be made every other day until finally once a week will suffice. If there should be any indication that the tuber moth is propagating, a second fumigation is in order.

This method of saving seed potatoes appears so simple, although effective, that it is feared that many growers may disregard it.

To grow all potatoes successfully the farmer should work overtime on a cleaning-up campaign which should begin at once on receipt of this bulletin. Small or useless tubers and tops should be promptly cleaned up and burned, and the land should be harrowed to break up clods and leave as few hiding places as possible for the moths. All weeds and other plants of the potato kind should be destroyed over large areas surrounding the potato fields.

It is particularly urged that potato growers cooperate in this work, which will lessen very materially the numbers of moths and hence reduce the chances for propagation. Could general cooperation be secured by legislation or otherwise it would be possible to restrict the distribution of this species to the area which it now occupies or to stamp it out where now established. Slipshod methods of raising potatoes at such a time as midsummer or early autumn are particularly dangerous, and in infested districts it is advisable in many cases to raise some crop other than potatoes, because unless protective and defensive measures are adopted at once there will be a serious reduction of the potato crop and similar trouble will be experienced during seasons to come.

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FARMERS' BULLETIN

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September 11, 1913.

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1819

AGRICULTURAL OUTLOOK.

WEATHER CONDITIONS DURING THE PAST MONTH WITH RELATION TO CROPS.

The severe heat that had prevailed over the middle western districts during the latter part of June and nearly the whole of July was maintained with but slight breaks throughout August, and during the first week of the present month, with even more severity than during July.

For the month of August as a whole the average temperature was above the normal over the entire country save at a few points along the Atlantic coast and in the lake region, where the averages were normal or slightly less.

In the great central valleys the temperature averaged abnormally high, the excess above the normal in Kansas, Missouri, Oklahoma and portions of surrounding States ranging from 6° to 10° per day. In the central portion of the excessively heated area, afternoon temperatures of 100° or higher were of almost daily occurrence during the month, and occasionally they rose to 110°, especially in Kansas and Oklahoma, exceeding in some cases the severe heat wave of the summer of 1901 in the same region. During the night hours the temperatures frequently did not go below 75°, and occasionally not below 80°, thus adding greatly to the discomfort of both human and animal life. Over the outlying districts temperature extremes were not unusual, the month as a whole being moderately cool over the Atlantic coast districts.

Precipitation during August was deficient over nearly the entire country and especially over the corn and cotton growing districts. In the great corn and cotton growing States of the trans-Mississippi region the precipitation was greatly deficient, the amounts over portions of Kansas, Oklahoma, and surrounding States, where excessive heat prevailed, being but a few tenths of an inch, and at some points no appreciable precipitation occurring during the entire month. Over the eastern portions of the cotton belt and the southern portion of the corn belt to eastward of the Mississippi there was likewise a large deficiency in the precipitation.

For the first week in September heat and drought conditions continued unabated throughout nearly the entire corn and cotton growing districts, the heat being even more excessive than for any previous week of the summer and the precipitation as a whole probably the least for any since the beginning of the season over the principal crop-growing districts.

As a result of the extreme heat and lack of rainfall over such an important portion of the agricultural districts of the country there has been a great reduction in the crop prospects over large regions between the Mississippi River and the Rocky Mountains, and a material reduction in many districts to the eastward. The corn-crop prospects as a whole have been greatly reduced; not since the great drought of June and July, 1901, has there been such widespread injury to that crop, and it is probable that the damage from the adverse weather of the present season will finally exceed that of 1901.

In the same region grass and other forage crops have been greatly injured, and the feeding of stock has already become necessary, with prospects of an insufficient supply for the coming winter.

In the cotton region the weather during August and the first week of September has been unfavorable over much of the region to westward of the Mississippi, but to the eastward it has been moderately favorable.

In the spring-wheat region the weather during the past month has been exceptionally favorable, and the wheat crop was harvested under favorable conditions; thrashing has likewise proceeded without serious interruptions.

As a result of the deficiency in rainfall the water supply, both for domestic use and for stock, has become greatly reduced, especially in the Middle and Southern Plains States and portions of Missouri and Iowa, and it has seriously diminished the supply in some of the more eastern portions of the country, especially in the southern drainage of the Ohio River and in central New York and northern Pennsylvania.

C. F. Marvin,
Chief Weather Bureau.

APPLE OUTLOOK.

The outlook is distinctly for an "off year" crop of apples. This is to some extent an effect of the generally abundant crop of 1912 in the more important commercial districts, which interfered with the formation of fruit buds in orchards where full vigor of growth was not maintained by adequate cultivation, fertilization, and spraying.

Untimely frosts and in some sections excessive rains at the blossoming time reduced the set of fruit on important commercial varieties in practically all the important districts, both east and west. East of the one-hundredth meridian the prolonged high temperature and deficient rainfall, which in considerable portions of the territory still continue unbroken, have prevented that development of large-sized fruit which sometimes occurs in a light crop year.

In scattered localities and limited districts the conditions are more favorable than throughout the country generally, and where thoroughly efficient culture and spraying have been practiced the prospective yield and quality of certain varieties are promising. This is the case with Greenings and Spys in the Lake Region, York Imperial in southeastern Pennsylvania, Pippins in the Blue Ridge section of Virginia, and Jonathan in portions of the Ozark region. Baldwin and Ben Davis, which are the varieties most largely represented in the older orchards of the "barrel" apple territory, are generally reported light in yield.

The Rocky Mountain and Pacific apple districts, which constitute the distinctive box apple territory, generally report the crop condition as considerably lower than last year. The largely increased area of orchard now coming into bearing age each year in the Pacific Northwest tends to counterbalance this, however, so that the outturn of fruit in that region is likely to be heavier than the condition figures would indicate.

Reports regarding the apple crop in foreign countries indicate greatly reduced yields in Canada and in Great Britain, France, and Germany. The outlook for export demand for merchantable apples is excellent.

Present indications are that the entire product of sound and clean fruit of good keeping quality will be needed to meet the consuming demand.

Long continuance of high temperatures or of moisture deficiency beyond September 10 would be likely to cause a material lowering of both quantity and quality of apples in barrel districts.

WILLIAM A. TAYLOR,
Chief Bureau of Plant Industry.

POTATO OUTLOOK.

The heavy hold-over crop from last season, the low prices, and general demoralization of the potato trade last autumn caused a slight shrinkage in acreage, especially in the late-potato districts. This, together with the adverse climatic conditions which have prevailed during the early growing season in portions of the territory, will tend to reduce the crop below the yield of last year and slightly below the 10-year average. The superlative condition of the crop in certain areas will tend to counteract this condition, but most of the areas that promise bountiful harvests this season gave large yields last season. It must be remembered, however, that in early September the crop is not yet made and a short period of cool, favorable weather may cause a great improvement in areas where the condition of the crop is backward. On the contrary, a period of adversity may greatly reduce yields in areas giving great promise at this time. The present outlook is for a sufficient supply for the normal needs of the country, but the total harvest will undoubtedly be much less than last season.

The crop in Maine promises the largest harvest yet recorded; the conditions in Michigan, Wisconsin, Minnesota, and North Dakota are normal, while the conditions in portions of Colorado are much better than at this time last year. Present indications are that the yields will be light in Massachusetts, Connecticut, New York, and Ohio, and as a large percentage of the aggregate crop is produced in this territory, the result will be felt in the markets of the East. The areas promising normal or slightly increased yields will without doubt make up any deficiency that might result from a short crop in the North Atlantic States, so that for the country as a whole the crop promises to be ample. Stated in percentages, the average condition of the crop is 10 per cent below the 10-year average, but about 10 per cent above the condition for the same season in 1911.

L. C. CORBETT,
Assistant Chief Bureau of Plant Industry.

HOG CHOLERA.

Hog cholera has existed in the United States for 75 years, and it is safe to say that in each of the last 25 years the farmers of this country have lost millions of hogs from this disease. It is estimated that during the year 1912 approximately $60,000,000 worth of hogs died of hog cholera.

The United States Department of Agriculture has been engaged continuously for more than 25 years in endeavoring to discover some method of preventing or curing hog cholera. As is now quite generally known, these experiments of the department finally resulted in the discovery of a serum that will prevent the disease when properly prepared and administered. The results of these experiments of the Department of Agriculture were brought to the attention of the authorities in all of the States, and as a result approximately 30 different States are engaged in the distribution of antihog-cholera serum to farmers. This work has undoubtedly resulted in a great saving to the individual farmer, but it has not resulted in the eradication or noticeable diminution of the disease in the country as a whole. The Department of Agriculture believes that, with this serum to use as a basis, a country-wide campaign looking to the elimination or control of hog cholera should be undertaken. Congress has recognized the importance of such work by an appropriation of $75,000, which became available on July 1 of this year. This appropriation authorizes the Department of Agriculture to demonstrate the best methods of controlling hog cholera and the work thus authorized has already begun, although, owing to the small amount of money available, it is necessarily restricted to a few localities.

The United States Department of Agriculture believes that success in any attempt to eradicate hog cholera will depend upon the establishment of efficient organizations by the State and Federal Governments, which will work together. They must, however, have the full cooperation and support of the farmers. With the organizations perfected the idea is that when hog cholera breaks out on one farm it will be the duty of those organizations then and there to restrict the disease to the one farm where it already exists by instituting suitable measures of quarantine and also by the administration of the protective serum to the droves on adjoining farms. As already indicated, the department is now testing out in a few counties this method of combating hog cholera. In the meantime, while the necessary information preliminary to a general campaign against hog cholera is being secured, farmers may do much to protect themselves and help to restrict the disease by a careful observance of a few simple rules, such as the following:

(1) Do not locate hog lots near a public highway, a railroad, or a stream. The germ of hog cholera may be carried along any one of these avenues.

(2) Do not allow strangers or neighbors to enter your hog lots and do not go into your neighbor's lots. The germ of hog cholera may be readily carried in a small amount of dirt on the shoes.

(3) Do not put new stock, either hogs or cattle, in lots with the herd already on the farm. Newly purchased hogs should be put in separate inclosures well separated from the herd on the farm, and kept under observation for three weeks, because practically all stock cars, unloading chutes, and pens are infected with hog cholera and hogs shipped by rail are therefore apt to contract hog cholera.

(4) Hogs sent to fairs should be quarantined for at least three weeks after they return to the farm.

(5) If hog cholera breaks out on a farm, separate the sick from the apparently healthy animals and burn all carcasses of dead animals on the day of death. Do not leave them unburned, for this will endanger all other farmers in the neighborhood. Dogs, crows, or buzzards may transport particles of flesh from dead hogs and thus carry the disease.

(6) If after the observance of all possible precautions hog cholera appears on your farm, notify the State veterinarian, or State Agricultural college, and secure serum for the treatment of those not affected. The early application of the serum is essential.

The Department of Agriculture does not distribute this hog-cholera serum direct to farmers. The department produces only such serum as is required for its own experimental work. Farmers, therefore, should appeal to their own State officials.

MARION DORSET,
Chief Biochemic Division, Bureau of Animal Industry.

AGRICULTURAL FORECAST.

GENERAL REVIEW.

By September 1 the crop season is usually sufficiently advanced to enable one to form a reasonably accurate estimate of the final outturn, whether above or below average. On September 1 of this year the composite average condition of all crops was 10.1 per cent below the average of the 10 years 1903–1912, and indicates smaller yields per acre than in any one of these 10 years. The month of August was unusually unfavorable, for conditions on August 1 were only 6.1 per cent below the average level. Compared with a year ago prospects are now about 12.2 per cent poorer. Last year crop prospects improved steadily as the season advanced, final outturn being the largest on record; this year, on the other hand, from the beginning of the season to September 1, prospects have tended downward as the season has advanced.

The aggregate acreage of all crops does not usually vary much from one year to another. This year the aggregate is about 1 per cent more than last year (the increase being due to a smaller amount of winterkilling of wheat this year) and about one-half of 1 per cent more than the acreage in crops two years ago.

Coincident with the decline in crop prospects during the past month, prices for staple crops made an unusual increase. Usually the average of prices received by producers for crops decreases during August, the average decrease in the past five years being 4.4 per cent; but during the past month the average level increased 8.7 per cent. In August of 1912 the price level decreased about 7 per cent. The price level on September 1 was 0.9 per cent lower than a year ago, 3.8 per cent lower than two years ago, and 0.3 per cent higher than the average September 1 prices of staple crops of the past five years. Prices of meat animals decreased slightly from July 15 to August 15 (0.7 per cent), compared with an increase of 3.6 per cent in like month of last year and an increase of 6.2 per cent two years ago. The level, however, is still unusually high, the index price of meat animals on August 15 being 9.8 per cent higher than on August 15 last year, 22.7 per cent higher than two years ago, and 8 per cent higher than three years ago.

TABLE 1.—*General condition of all crops, by States, as reported Sept. 1; comparisons are with aggregate average crop prospect on Sept. 1 of recent years (mostly 10 years).*

States or Territories.	1913	10-year average.	States or Territories.	1913	10-year average.	States or Territories.	1913	10-year average.
Maine	95.3	100	Ohio	96.5	100	Texas	95.1	100
New Hampshire	88.0	100	Indiana	93.7	100	Oklahoma	63.7	100
Vermont	96.1	100	Illinois	78.0	100	Arkansas	92.3	100
Massachusetts	100.2	100	Michigan	92.4	100	Montana	95.1	100
Rhode Island	97.2	100	Wisconsin	108.0	100	Wyoming	91.6	100
Connecticut	90.7	100	Minnesota	106.6	100	Colorado	89.9	100
New York	90.7	100	Iowa	101.9	100	New Mexico	83.5	100
New Jersey	96.4	100	Missouri	65.1	100	Arizona	114.3	100
Pennsylvania	96.2	100	North Dakota	95.4	100	Utah	88.5	100
Delaware	92.0	100	South Dakota	87.1	100	Nevada	103.5	100
Maryland	90.4	100	Nebraska	72.8	100	Idaho	100.2	100
Virginia	102.1	100	Kansas	58.7	100	Washington	102.7	100
West Virginia	89.5	100	Kentucky	74.9	100	Oregon	102.8	100
North Carolina	102.1	100	Tennessee	83.5	100	California	84.7	100
South Carolina	100.4	100	Alabama	92.4	100	United States	89.9	100
Georgia	98.0	100	Mississippi	92.9	100			
Florida	104.7	100	Louisiana	97.2	100			

TABLE 2.—*Index figures of yield per acre of ten products, 100 representing the average yield per acre of the 10 years, 1903–1912.*

	Corn.	Wheat.	Oats.	Barley.	Potatoes.	Hay.	Cotton.	Tobacco.	Flax.	Rye.	10 crops combined.
1912	108	113	126	117	118	103	102	95	109	104	109
1911	89	88	82	83	84	77	112	109	78	97	90
1910	103	98	106	89	98	93	91	98	58	99	98
1909	95	110	100	91	111	100	83	98	104	100	97
1908	97	99	84	99	89	107	104	100	107	102	99
1907	96	99	80	94	99	102	96	103	100	102	96
1906	112	110	105	111	107	95	109	104	113	104	107
1905	107	103	114	105	91	108	100	99	123	102	105
1904	99	89	108	107	115	107	110	99	115	94	103
1903	94	91	95	104	88	108	93	95	93	96	96
1903–12	100	100	100	100	100	100	100	100	100	100	100
1913[1]	80	107	93	90	88	92	91	91	93	101	89

[1] Indicated Sept. 1.

It may be observed from the above table that rye and wheat are the only two crops that promise above their 10-year average yield per acre; and that the average for all of the crops is lower than any of the 10 years.

THE CEREAL CROPS.

SPRING WHEAT.

The information gathered by the bureau indicated a condition of 75.3 at harvest time, as against 90.8 in 1912 and 76.9 for a 10-year average. This justifies a forecast of 13 bushels per acre, compared with 17.2 bushels in 1912 and an average yield of 13.3 bushels for the years 1908 to 1912; and a total production on the planted area of 18,663,000 acres previously estimated, which is 3 per cent less than the estimated area in 1912, of 243,000,000 bushels, as against 330,000,000 bushels in 1912 and 191,000,000 bushels in 1911. This is an increase of 4.3 per cent over the production forecast for last month, which is principally due to more favorable conditions in North Dakota and Minnesota.

WINTER WHEAT.

The winter wheat crop of 1913, according to the information gathered by the bureau on August 1, is estimated to be 511,000,000 bushels, which would be the largest ever grown in the United States. This figure is based upon an acreage of 30,938,000, which is 16.4 per cent greater than the acreage of the 1912 crop and the largest of any year except 1903, and a yield of 16.5 bushels per acre, which is higher than either the 1912 yield of 15.1 or the five-year average of 15.2 for the years 1908 to 1912, and is exceeded only by the record yield of 16.7 bushels per acre in 1906.

ALL WHEAT.

Combining the estimated winter wheat crop of 511,000,000 bushels with the forecasted spring wheat crop of 243,000,000 bushels gives a total estimated crop of 754,000,000 bushels, which would be the largest wheat crop ever produced in the United States, following the crop of 730,000,000 bushels in 1912, which was one of the country's three largest crops of record, and 621,000,000 in 1911. This bumper crop was grown upon 49,601,000 acres, which exceeds the 1912 acreage by 8.3 per cent, and is the largest acreage of wheat ever harvested in this country, with the exception of that of 1901, which exceeded it by 295,000 acres. The indicated yield is 15.2 bushels per acre, which falls below the 15.9 yield of 1912, but is above the 14.5 average for the years 1908 to 1912.

This favorable showing results principally from the fine outturn of the winter wheat crop, which had been made before the advent of the present drought in its main centers of production. The improvement of 1.3 per cent over last month's forecast is due mainly to improved spring wheat conditions in North Dakota and Minnesota.

The average price paid producers September 1 was 77.1 cents, compared with 77.1 cents on August 1, 85.8 cents at the same date in 1912, and a five-year average of 90.1 cents.

The International Institute of Agriculture at Rome, Italy, cables under date of August 23 an estimated production of 2,684,000,000 bushels of wheat in the following countries, which is 3.9 per cent more than was produced in the same countries last year; Belgium, Bulgaria, Denmark, Spain, Italy, Luxemburg, Russia: Switzerland, United States, Canada (winter wheat), India, Japan, Algeria, Tunis, Prussia, England, Wales, Hungary (excluding Croatia and Slavonia).

This includes a preliminary estimate of 812,541,000 bushels production for Russia. Preliminary official estimates of wheat production for that country in previous years have tended to be somewhat excessive.

This list includes all of the principal wheat-producing countries that issue official data of wheat production, except Austria, France, Germany outside of Prussia, Roumania, Argentina, Australia, and Canada (for spring wheat), which countries produced in 1912 (Australia and Argentina 1912–1913) approximately 1,033,000,000 bushels.

CORN.

The information gathered by the bureau indicates a condition of 65.1, compared with 82.1 in 1912 and the 10-year average of 80.9, which justifies a forecast of 22 bushels per acre, against a yield of 29.2 in 1912 and an average of 26.5 for the five years 1908 to 1912. This promises the lowest yield since 1901, when it averaged 16.7, and upon the estimated area of 106,884,000 acres, which is but two-tenths of 1 per cent less than last year, and except for it the largest ever planted to corn in this country, it indicates a total production of 2,351,000,000 bushels, which compares with last year's "bumper" crop of 3,125,000,000 bushels, and 2,531,000,000 in 1911, and is the lowest since 1903.

This forecast is 12 per cent lower than that for August 1, owing to the increased deterioration from drought in important corn States. The condition in Kansas is but 10 per cent of a normal, and in the immediately adjoining States of Nebraska, Missouri, and Oklahoma ranges near 40.

The average price paid to producers on September 1 was 75.4, compared with 65.4 on August 1, 77.6 on September 1, 1912, and 71.5 for the five-year average 1907–1911.

OATS.

The information gathered by the bureau indicated that the condition of the crop at harvest time was 74, as compared with 92.3 in 1912 and a 10-year average of 79.3, which justifies the forecast of a yield of 27.8 bushels per acre, against 37.4 in 1912 and 29.7 average for the years 1908 to 1912, and a total production of 1,066,000,000 bushels, compared with 1,418,000,000 in 1912 and 922,000,000 in 1911. The previously estimated area of 38,341,000 acres planted to this crop is 1.1 per cent in excess of last year's acreage, and the largest acreage ever harvested in this country.

This forecasted production, based upon the harvested condition, is 3.7 per cent higher than last month's forecast, which was based upon the indications on August 1.

While the indicated production is only about 75 per cent of last year's record crop, it is one of the four crops of oats in excess of a billion bushels.

The average price paid producers September 1 was 39.3 cents, compared with 37.6 on August 1, 35 cents at the same date in 1912, and a five-year average of 40.7 cents.

The International Institute of Agriculture estimates a total production of 2,898,000,000 bushels of oats in the countries named below, which is 10.3 per cent less than produced in the same countries last year:

Belgium, Bulgaria, Denmark, Spain, Italy, Luxemburg, Russia, Switzerland, United States, Japan, Algeria, Tunis, Prussia, England, Wales, Hungary (excluding Croatia and Slavonia).

The figures given for Russia are 1,073,233,000 bushels, and for Prussia 398,223,000 bushels.

These countries include all those of importance in the production of this cereal that issue official data of its production, except Austria, Argentina, Canada, France, Germany outside of Prussia, and Roumania, which produced in 1912 (Argentina, 1912–13) approximately 1,173,000,000 bushels.

BARLEY.

The information gathered by the bureau indicated that the condition of barley at time of harvest was 73 4, as compared with 88 9 in 1912 and a 10-year average of 81.1, which justifies a forecast of a yield of 23.2 bushels per acre, against 29.7 in 1912 and an average of 24 5 for the years 1908 to 1912. This yield indicates upon the previously estimated area of 7,255,000 acres planted to this crop, which is 3 7 per cent less than last year, a total probable production of 168,000,000 bushels, against 224,000,000 bushels produced in 1912 and 160,000,000 in 1911.

There has been no change in the production forecasted from conditions last month.

The average price paid producers September 1 was 55.2 cents, compared with 50 8 on August 1, 53.5 cents at the same date in 1912. and a five-year average of 59.7 cents.

The International Institute of Agriculture states that the total production of barley this year is 1,143,000,000 bushels in the following-named countries, which is 0.1 per cent more than produced in the same countries last year:

Belgium, Bulgaria, Denmark, Spain, Italy, Luxemburg, Russia, Switzerland, United States, Japan, Algeria, Tunis, Prussia, England, Wales, Hungary (excluding Croatia and Slavonia).

The figures given for Russia are 479,250,000 bushels.

These countries include all those of importance in the production of this cereal that issue official data of its production except Canada, France, Germany outside of Prussia, and Roumania, which produced in 1912 approximately 195,000,000 bushels.

RYE.

The information gathered by the bureau in August indicated that the yield was 16.3 bushels per acre, as compared with 16.8 bushels in 1912 and 16.2, the average for the years 1908 to 1912, which, upon the estimated area of 2,134,000 acres, which is 0.8 per cent greater than in 1912, indicates a total production of 35,000,000 bushels, against 36,000,000 for 1912 and 33,000,000 in 1911.

The average price paid producers September 1 was 63 cents, compared with 60.7 on August 1, 70.8 cents at the same date in 1912, and a five-year average of 73.4 cents.

The International Institute of Agriculture reports preliminary figures of production in Russia at 895,084,000 bushels, and the total production in the following-named countries at 1,408,000,000 bushels, which is 8.8 per cent less than was produced in the same countries last year:

Belgium, Bulgaria, Denmark, Spain, Italy, Luxemburg, Russia, Switzerland, United States, Prussia, and Hungary (excluding Croatia and Slavonia).

These countries include all those of importance in the production of this cereal that issue official data of its production except Austria, Canada, France, Germany outside of Prussia, and Roumania, which produced in 1912 approximately 288,000,000 bushels.

BUCKWHEAT.

The information gathered by the bureau shows a condition of 75.4, as against 91.6 in 1912 and a 10-year average of 87, which justifies a forecast of a yield of 18.2 bushels per acre, against 22.9 bushels in 1912 and 21 average for the years 1908 to 1912, indicating a total production upon the planted area of 841,000 acres (the same acreage as last year) of approximately 15,000,000 bushels, against 19,000,000 bushels in 1912 and 18,000,000 in 1911. This is a reduction in prospective production of 11.8 per cent from the forecast of last month, due to drought in New York and Pennsylvania, which two States normally produce over two-thirds of the total United States crop.

The price paid producers on September 1 was 70, compared with 72.4 August 1, 76.6 on September 1, 1912, and a five-year average of 76.

RICE.

The information gathered by the bureau shows a condition on September 1 of 88 per cent, compared with 88.8 in 1912 and 89.2 in 1911, forecasting a yield of 32.8 bushels per acre, against 34.7 in 1912 and 33.7 in 1911. While the forecasted yield is slightly lower than that of the preceding two years, upon the estimated area of 824,100 acres, which is an increase of 14 per cent over last year, it forecasts a total production of approximately 27,000,000 bushels, as against 25,000,000 in 1912 and 23,000,000 in 1911. This year's crop has the largest acreage and promises the largest production in the history of this crop in the United States.

FLAX.

The information gathered by the bureau shows a condition, September 1, of 74.9, compared with 86.3 in 1912 and a 10-year average of 80.9, which justifies a forecast of a yield of 8.4 bushels per acre, as compared with 9.8 bushels in 1912 and 8.2 in the years 1908 to 1912. Upon the estimated area of 2,425,000 acres, representing the large reduction of 14.9 per cent from the area in 1912, this indicates a probable total production of approximately 20,000,000 bushels, compared with 28,000,000 in 1912 and 19,000,000 in 1911.

The average price paid to producers on September 1 was 127.8 cents, against 118.6 on August 1, 162.6 on September 1, 1912, and a 163.8 average for the previous five years.

The International Institute of Agriculture estimates a production of 42,000,000 bushels in Belgium, Spain, United States, India, and Japan combined, which is 22.8 per cent less than the same countries produced last year. This estimate does not take into account the crop of Canada, which was approximately 21,000,000 bushels in 1912, nor the crop in Argentina and Australia for 1912–13, which aggregated 61,000,000 bushels.

HAY AND FORAGE.

The preliminary estimate of the yield of hay indicates an average of 1.31 tons per acre this year, which compares with 1.47 tons estimated last year and 1.43 tons, the 10-year average yield per acre. The total production is estimated at 63,460,000 tons, which is 12.7 per cent less than the production of last year, 15.6 per cent more than the short crop of 1911, and 8.5 per cent less than the 1910 crop. The quality of the crop is average.

The alfalfa, millet, and kafir crops are grown heavily where the drought this year is most severe; consequently these crops are particularly short.

The average price of hay (loose) to producers on September 1 was $11.89 per ton, as compared with $12.14 a year ago, $14.61 two years ago, $11.87 three years ago, and $9.67 four years ago, on September 1.

COTTON.

Information gathered by the Department of Agriculture indicates that the condition of the cotton crop on August 25 was 68.2 per cent of a normal, as compared with 79.6 on July 25, 74.8 on August 25, 1912, 73.2 on August 25, 1911, and 74.7, the average on August 25 of the past 10 years. In the early part of the season conditions were favorable in the western cotton States and unfavorable in the eastern cotton States; as the season has advanced, however, prospects have been declining in the west and improving somewhat in the east. A lower condition than 68.2 on August 25 has been estimated only once in the past 10 years, in 1909, when the condition was 63.7, in which year the yield per acre was 154 pounds.

The detailed estimates, by States, of acreage, condition in per cent of normal, and price per pound, and the amount ginned to September 1 as reported by the Census Bureau, are given in Table 3.

TABLE 3.—*Cotton: Acreage, condition, price per pound; and amount ginned.*

State.	Preliminary area 1913 (000 omitted).	Condition Aug. 25.			Price per pound Sept. 1.			Ginned prior to Sept. 1 (census).		
		1913	1912	10-year average.	1913	1912	5-year average.	1913	1912	1911
	Acres.	*P.ct.*	*P.ct.*	*P.ct.*	*Cts.*	*Cts.*	*Cts.*	*Bales.*	*Bales.*	*Bales.*
Virginia	50	80	80	82	12.6	11.1	11.9	....	....	....
North Carolina	1,560	78	75	78	11.8	11.5	12.1	188	674	1,245
South Carolina	2,716	77	73	77	11.7	11.7	12.0	7,272	4,260	19,364
Georgia	5,336	76	70	77	11.7	11.4	11.9	72,622	34,526	134,431
Florida	230	81	73	78	14.0	14.0	14.1	2,956	1,832	3,796
Alabama	3,804	72	75	76	11.6	11.1	11.7	44,525	12,824	40,501
Mississippi	3,045	69	70	75	12.0	11.5	11.6	2,027	442	1,865
Louisiana	1,166	67	74	69	11.8	11.0	11.4	7,566	1,724	8,120
Texas	11,732	64	76	72	11.9	11.1	11.6	649,691	675,249	557,544
Arkansas	2,117	72	77	77	11.7	11.2	11.5	2,200	81	170
Tennessee	823	80	76	83	11.8	11.1	11.6	9	....	5
Missouri	113	72	78	84	11.5	9.2	10.5	....	....	....
Oklahoma	2,916	45	84	76	11.7	11.5	11.5	4,913	323	4,255
California	14	96	95	......	......	......	......	....	....	....
United States	35,622	68.2	74.8	74.7	11.8	11.3	11.7	794,006	730,935	771,297

SUPPLY OF STOCK HOGS.

Information as to the number of stock hogs in the United States indicates that on September 1 the supply was practically the same as a year ago. On April 1 it was estimated that the number of breeding sows in the country was about 1 per cent less than on April 1, 1912. The numbers compared with a year ago in the important States are estimated as follows: Georgia, 110; Ohio, 103; Indiana, 102; Illinois, 104; Wisconsin, 104; Iowa, 92; Missouri, 100; Nebraska, 100; Texas, 102. The condition as to health of hogs is low, 89.8 per cent of normal, compared with a 10-year average of 95.1, the range in the 10 years being from 92.1 last year to 96.6 in 1910. Reports are particularly low in Iowa, 71, compared with an average of 95, and 86 in 1904, the lowest of any of the past 15 years.

HEMP AND BLUE-GRASS SEED.

These crops are grown mostly in Kentucky, where they have suffered, together with most crops in this State, from dry weather. The condition of hemp on September 1 was 65 per cent of normal, compared with a 10-year average of 81.2 per cent of normal. Reports from Kentucky indicate that the production of blue-grass seed this season is only 47 per cent of a normal production. Last year the production was unusually large, being estimated at 117 per cent of a normal production.

VEGETABLES.

All vegetables were more or less adversely affected by the drought of the past month, conditions generally being below average conditions. Information as to the potato crop indicates a yield of about 88 bushels per acre, which compares with 113 bushels last year and an average of 96 bushels in the five years 1908-1912. A total production of about 325,000,000 bushels is thus indicated, compared with a production of 421,000,000 bushels last year and 293,000,000 the year before.

SUBTROPICAL FRUITS AND NUTS.

The condition of subtropical fruits and nuts in California and Florida on September 1 is shown in Table 4, 100 representing normal conditions. Prospects are generally poorer than a year ago and two years ago.

TABLE 4.—*Condition of subtropical fruits and nuts in California and Florida on Sept. 1.*

	California.			Florida.		
	1913	1912	1911	1913	1912	1911
Apricots	65	83	64	......	......	......
Almonds	55	83	66	......	......	......
Prunes	70	89	78	......	......	......
Olives	78	80	90	......	......	......
Walnuts	77	86	84	......	......	......
Grapes:						
Wine	80	87	86	......	......	......
Raisin	75	85	82	......	......	......
Table	80	87	88	......	......	......
Oranges	76	87	94	89	97	75
Lemons	61	89	95	......	97	81
Grapefruit	......	......	......	84	94	62
Limes	......	......	......	100	95	81

TABLE 5.—*Corn and wheat crops: Forecast based upon returns to Sept. 1, with details, by States.*

States and Territories.	Corn.					Winter wheat.		Spring wheat, condition.		All wheat, price.	
	Acreage, 1913, preliminary (000 omitted).	Condition.		Price.		Production (000 omitted).					
		Sept. 1, 1913.	10-year average.	Sept. 1, 1913.	5-year average.	1913 (preliminary).	1912 (final).	Sept. 1, 1913.	10-year average.	Sept. 1, 1913.	5-year average.
	Acres.	*P. ct.*	*P. ct.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*	*P. ct.*	*P. ct.*	*Cts.*	*Cts.*
Maine	16	65	86	89	83	......	......	95	95	......	109
New Hampshire	22	72	86	83	81	......	......	......	......	......	......
Vermont	46	80	86	82	80	......	......	85	89	107	113
Massachusetts	48	76	87	85	82	......	......	......	......	......	......
Rhode Island	11	81	91	105	92	......	......	......	......	......	......
Connecticut	61	73	88	85	85	......	......	......	......	......	......
New York	527	67	79	81	78	6,700	5,360	......	......	89	98
New Jersey	270	84	84	84	82	1,408	1,462	......	......	95	100
Pennsylvania	1,463	81	83	81	78	21,862	22,320	......	......	89	96
Delaware	197	80	87	73	79	1,638	1,942	......	......	88	94
Maryland	677	81	85	77	81	8,073	8,985	......	......	88	94
Virginia	1,980	85	85	85	88	10,064	8,596	......	......	93	99
West Virginia	732	84	82	84	88	2,957	3,378	......	......	95	104
North Carolina	2,836	87	84	95	97	7,055	5,322	......	......	97	109
South Carolina	1,992	86	83	102	99	972	727	......	......	117	120
Georgia	4,066	87	87	99	97	1,732	1,228	......	......	120	124
Florida	675	92	85	90	90	......	......	......	......	......	......
Ohio	3,994	81	82	72	73	34,326	9,760	......	......	86	94
Indiana	4,896	81	84	70	68	39,534	10,080	......	......	83	91
Illinois	10,551	62	84	73	66	41,963	9,819	......	......	84	90
Michigan	1,641	80	80	72	70	12,714	7,009	......	......	85	93
Wisconsin	1,632	94	82	65	68	1,749	1,696	89	83	84	95
Minnesota	2,357	95	83	63	59	......	......	88	79	79	94
Iowa	9,947	76	81	66	62	7,816	6,900	85	83	78	86
Missouri	7,393	41	80	77	70	39,586	23,750	......	......	81	89
North Dakota	341	87	80	52	65	......	......	70	72	76	91
South Dakota	2,620	78	84	60	59	......	......	65	76	74	88
Nebraska	7,609	37	78	72	59	58,106	50,850	73	76	72	81
Kansas	7,424	10	70	81	65	86,515	91,450	40	60	75	84
Kentucky	3,636	59	86	86	81	9,765	6,860	......	......	92	95
Tennessee	3,365	65	86	83	82	8,208	7,077	......	......	95	98
Alabama	3,244	78	88	96	93	374	318	......	......	104	113
Mississippi	3,230	81	85	86	86	126	96	......	......	92	108
Louisiana	1,931	85	84	83	76	......	......	......	......	......	......
Texas	7,081	78	74	77	73	11,812	11,025	......	......	84	97
Oklahoma	5,176	39	69	77	65	16,380	20,096	......	......	75	86
Arkansas	2,500	71	82	82	80	1,262	940	......	......	82	94
Montana	31	90	85	115	108	13,261	11,638	86	89	66	86
Wyoming	18	89	86	62	79	800	896	92	93	0	97
Colorado	420	70	83	70	76	4,452	4,728	79	87	73	89
New Mexico	87	61	82	76	96	725	660	80	86	77	99
Arizona	17	85	90	115	110	864	651	86	89	108	109
Utah	9	88	93	85	80	3,910	3,840	92	95	66	85
Nevada	1	92	93	101	......	322	412	97	97	90	120
Idaho	12	96	93	67	85	9,069	9,614	95	88	65	74
Washington	34	86	88	74	82	28,998	27,269	82	80	69	79
Oregon	21	96	88	85	88	11,599	16,884	90	81	75	83
California	45	78	89	86	91	3,822	6,290	......	......	92	97
United States	106,884	65.1	80.9	75.4	71.5	510,519	399,919	75.3	76.9	77.1	90.1

Table 6.—*Grain crops: Forecast based upon returns to Sept. 1, with details, by States.*

States and Territories.	Oats.				Barley.				Buckwheat, condition.		Rice, condition.		Flax, condition.	
	Condition.		Price.		Condition.		Price.							
	Sept. 1, 1913.	10-year average.	Sept. 1, 1913.	5-year average.	Sept. 1, 1913.	10-year average.	Sept. 1 1913.	5-year average.	Sept. 1, 1913.	10-year average.	Sept. 1, 1913.	10-year average.	Sept. 1, 1913.	10-year average.
	P. ct.	*P. ct.*	*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Maine	97	95	54	60	91	93	79	84	93	91	......	......	......	......
N. Hampshire	91	92	58	62	91	89	90	86	91	93	......	......	......	......
Vermont	93	92	57	59	91	92	92	86	87	92	......	......	......	......
Massachusetts	84	92	54	62	......	......	......	......	83	89	......	......	......	......
Rhode Island	80	88	......	56	......	......	......	......	......	......	......	......	......	......
Connecticut	80	88	55	61	......	......	......	......	77	92	......	......	......	......
New York	86	87	47	51	86	86	73	78	66	86	......	......	......	......
New Jersey	80	85	47	55	......	......	......	......	81	85	......	......	......	......
Pennsylvania	83	86	46	50	85	87	63	66	79	88	......	......	......	......
Delaware	78	84	50	46	......	......	......	......	86	88	......	......	......	......
Maryland	79	84	46	50	87	88	70	61	84	88	......	......	......	......
Virginia	84	80	51	55	88	92	68	72	84	87	......	......	......	......
West Virginia	84	84	52	56	......	......	......	......	83	87	......	......	......	......
North Carolina	84	80	56	63	......	......	......	......	80	89	80	86	......	......
South Carolina	88	80	68	70	......	......	......	......	......	......	82	83	......	......
Georgia	83	84	64	69	......	......	......	......	......	......	82	87	......	......
Florida	......	82	67	75	......	......	......	......	......	......	88	86	......	......
Ohio	72	82	39	40	70	83	54	65	75	85	......	......	......	......
Indiana	51	78	38	37	69	84	50	61	78	85	......	......	......	......
Illinois	53	78	39	37	79	90	49	61	78	84	......	......	......	......
Michigan	78	81	39	41	82	84	59	65	77	84	......	......	......	......
Wisconsin	90	83	37	41	80	85	55	66	89	86	......	......	87	85
Minnesota	87	81	35	35	78	81	53	56	87	85	......	......	81	83
Iowa	83	81	36	33	78	84	54	57	80	86	......	......	86	86
Missouri	56	73	44	39	78	83	......	73	55	84	......	......	43	74
North Dakota	72	77	32	38	71	75	49	54	......	......	......	......	73	79
South Dakota	70	80	34	35	64	79	51	56	......	......	......	......	68	85
Nebraska	70	72	40	35	60	75	43	48	74	87	......	......	74	85
Kansas	54	65	45	41	40	63	50	50	60	82	......	......	60	73
Kentucky	66	77	52	52	87	85	75	73	......	......	......	......	......	......
Tennessee	76	82	52	51	80	86	70	83	76	90	......	......	......	......
Alabama	80	84	64	68	......	......	......	......	......	......	85	86	......	......
Mississippi	80	79	64	65	......	......	......	......	......	......	85	87	......	......
Louisiana	82	79	57	58	......	......	......	......	......	......	87	89	......	......
Texas	76	69	43	49	69	75	64	88	......	......	90	90	......	......
Oklahoma	50	66	44	41	40	69	67	58	......	......	......	......	63	70
Arkansas	77	76	51	54	......	......	......	......	......	......	86	88	......	......
Montana	88	90	39	47	90	91	49	70	......	......	......	......	84	88
Wyoming	92	93	47	56	90	93	86	74	......	......	......	......	......	......
Colorado	76	89	49	53	80	91	56	60	......	......	......	......	55	......
New Mexico	76	86	49	56	84	85	59	66	......	......	......	......	......	......
Arizona	85	94	55	83	90	95	67	82	......	......	......	......	......	......
Utah	94	97	38	51	94	96	47	57	......	......	......	......	......	......
Nevada	96	97	55	82	96	96	85	92	......	......	......	......	......	......
Idaho	96	92	34	45	96	92	53	57	......	......	......	......	......	......
Washington	92	88	40	48	91	88	50	61	......	......	......	......	......	......
Oregon	102	87	40	45	92	87	55	62	......	......	......	......	......	......
California	70	86	55	55	66	85	66	66	......	......	95	......	......	......
United States	74.0	79.3	39.3	40.7	73.4	81.1	55.2	59.7	75.4	87.0	88.0	89.2	74.9	80.9

TABLE 7.—*Hay and forage crops: Forecast based upon returns to Sept. 1, with details, by States.*

States and Territories.	Hay (all tame).								Alfalfa, production.[1]		Kafir corn, condition.		Millet, condition.	
	Yield per acre.		Production (000 omitted).		Quality.		Price.							
	1913.	10-year average.	1913 (preliminary).	1912 (final).	1913.	10-year average.	1913.	5-year average.	1913.	7-year average.	1913.	7-year average.	1913.	7-year average.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*P. ct.*	*P. ct.*	*Dolls.*	*Dolls.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Maine	1.00	1.12	1,194	1,428	96	95	14.70	13.97	.....	.....	.....	.....	82	90
New Hampshire	1.00	1.10	491	626	95	95	16.30	15.80	.....	.....	.....	.....	75	92
Vermont	1.28	1.31	1,280	1,515	97	96	13.70	13.22	.....	.....	.....	.....	87	89
Massachusetts	1.21	1.25	577	596	94	94	20.10	19.86	.....	.....	.....	.....	78	89
Rhode Island	1.17	1.16	69	66	96	96	22.50	22.10	.....	.....	.....	.....	80	.....
Connecticut	1.14	1.17	432	436	94	94	18.50	20.07	96	.....	.....	.....	79	89
New York	1.14	1.23	5,327	5,900	92	90	14.00	14.40	84	90	.....	.....	75	84
New Jersey	1.30	1.34	471	521	92	90	18.00	16.80	91	89	.....	.....	81	85
Pennsylvania	1.32	1.35	4,146	4,537	92	90	13.70	14.44	91	88	.....	.....	84	87
Delaware	1.30	1.41	94	96	90	88	15.00	13.79	100	91	.....	.....	81	.....
Maryland	1.26	1.29	475	575	87	87	12.20	15.60	84	86	.....	.....	84	82
Virginia	1.27	1.23	922	889	90	87	14.00	15.21	95	86	.....	.....	87	84
West Virginia	1.21	1.31	875	1,028	88	86	14.20	14.68	92	87	.....	.....	88	83
North Carolina	1.31	1.47	384	381	90	88	15.50	15.55	100	85	.....	.....	85	86
South Carolina	1.16	1.33	225	223	88	88	17.80	17.00	105	87	.....	.....	86	82
Georgia	1.36	1.52	321	316	90	89	18.00	17.14	85	87	.....	.....	84	86
Florida	1.30	1.38	57	54	91	87	17.00	16.47	.....	.....	.....	.....	.....	.....
Ohio	1.30	1.37	3,848	4,026	91	90	11.10	12.18	94	87	.....	.....	81	88
Indiana	1.00	1.33	1,696	2,582	84	89	12.40	11.56	90	88	.....	.....	78	86
Illinois	.98	1.31	2,388	3,266	88	92	13.30	11.70	91	89	60	81	70	85
Michigan	1.05	1.32	2,464	3,185	93	92	12.60	12.33	89	87	.....	.....	85	84
Wisconsin	1.62	1.51	3,755	3,600	92	93	10.10	12.46	100	88	94	.....	94	85
Minnesota	1.50	1.57	2,492	2,541	92	92	6.50	7.84	98	88	.....	.....	91	87
Iowa	1.48	1.44	5,287	4,952	97	94	9.00	8.62	96	89	.....	.....	90	86
Missouri	.60	1.24	1,702	4,143	79	89	13.20	9.41	73	87	53	82	49	82
North Dakota	1.14	1.28	386	510	89	91	5.20	5.78	110	86	.....	.....	79	80
South Dakota	1.20	1.32	552	672	92	92	5.90	6.26	94	86	.....	.....	77	85
Nebraska	1.34	1.43	1,541	1,552	91	92	7.50	7.21	79	84	54	85	62	84
Kansas	.90	1.37	1,230	2,440	81	91	12.70	7.17	60	84	39	82	27	77
Kentucky	.87	1.31	624	1,002	81	87	15.90	13.28	75	86	.....	.....	67	84
Tennessee	1.21	1.46	1,031	1,154	89	87	15.70	13.67	77	88	.....	.....	68	87
Alabama	1.36	1.63	284	261	90	88	14.50	13.41	78	85	.....	.....	80	86
Mississippi	1.33	1.61	270	297	86	88	12.10	13.36	82	82	.....	.....	81	85
Louisiana	1.50	1.79	224	234	90	90	12.60	11.74	82	85	.....	.....	76	.....
Texas	1.16	1.48	427	542	84	87	11.00	10.30	80	78	75	78	70	74
Oklahoma	.80	1.23	308	481	75	88	10.40	6.98	60	81	50	82	52	76
Arkansas	1.42	1.44	398	352	84	88	12.00	10.85	80	86	75	80	72	81
Montana	1.80	1.82	1,152	1,216	94	94	8.40	9.94	97	96	.....	.....	80	88
Wyoming	1.90	2.21	902	859	99	96	7.50	9.16	100	94	.....	.....	90	87
Colorado	2.05	2.34	1,765	1,905	94	91	8.40	9.65	88	89	74	78	70	80
New Mexico	2.08	2.38	393	436	93	90	13.00	10.62	91	90	64	79	65	.....
Arizona	4.00	3.22	496	384	91	92	11.50	10.58	105	92	96	92	96	.....
Utah	2.33	2.95	867	1,023	92	95	8.50	7.95	91	91	.....	.....	99	92
Nevada	2.75	2.61	654	681	97	96	9.00	9.79	102	97	.....	.....	91	.....
Idaho	2.80	2.93	1,977	1,938	92	96	6.90	7.63	100	95	.....	.....	97	.....
Washington	2.30	2.28	1,803	1,707	95	94	10.20	11.81	99	94	.....	.....	89	.....
Oregon	2.10	2.10	1,642	1,738	95	95	8.40	9.43	97	94	.....	.....	97	.....
California	1.50	1.83	3,562	3,825	95	94	13.30	10.24	96	95	85	90	.....	92
United States	1.31	1.43	63,460	72,691	91.7	91.7	11.89	11.49	83.3	90.0	57.9	81.8	62.6	81.8

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[1] Production compared with a full crop.

TABLE 8.—*Fruit crops: Forecast based upon returns to Sept. 1, with details, by States.*

States and Territories.	Apples.				Pears, condition.		Peaches, production.[1]		Grapes, condition.		Cranberries, condition.	
	Condition.		Price.									
	Sept. 1, 1913.	10-year average.	Aug. 15, 1913.	Aug. 15, 1912.	Sept. 1, 1913.	5-year average.	Sept. 1, 1913.	10-year average.	Sept. 1, 1913.	10-year average.	Sept. 1, 1913.	7-year average.
	P. ct.	*P. ct.*	*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Maine	43	64	65	79	65	82	......	......	......	......	71	79
New Hampshire	42	62	95	74	75	83	75	70	79	78	67	80
Vermont	24	65	110	80	69	81	......	......	72	81	......	......
Massachusetts	55	62	105	85	90	78	70	50	87	83	80	76
Rhode Island	72	62	92	120	96	81	94	50	88	78	88	76
Connecticut	67	64	75	80	93	81	81	61	83	80	85	85
New York	35	58	72	65	81	70	67	58	65	82	78	86
New Jersey	55	60	73	70	57	68	42	57	78	84	70	77
Pennsylvania	43	59	80	65	60	68	41	51	61	79	......	......
Delaware	39	63	60	50	25	61	38	41	76	82	......	......
Maryland	40	65	70	50	40	66	40	52	61	79	......	......
Virginia	33	58	60	42	29	57	24	50	74	78	......	......
West Virginia	12	54	100	48	15	57	12	46	53	71	......	......
North Carolina	36	60	73	65	30	59	26	58	80	80	......	......
South Carolina	29	57	115	87	36	64	30	61	78	77	......	......
Georgia	45	56	96	68	39	62	30	62	78	80	......	......
Florida	......	......	......	......	38	61	45	67	......	......	......	......
Ohio	80	46	98	65	50	64	32	42	58	78	......	......
Indiana	63	46	60	65	67	57	69	43	80	78	80	77
Illinois	66	40	61	70	66	43	74	37	81	77	......	......
Michigan	52	55	50	58	70	67	54	54	78	80	75	75
Wisconsin	88	59	65	84	90	56	......	......	93	82	81	78
Minnesota	97	69	70	135	......	......	......	......	86	81	......	78
Iowa	74	51	59	99	65	35	79	28	86	75	......	......
Missouri	38	47	60	50	44	40	72	34	68	72	......	......
North Dakota	......	......	......	......	......	......	......	......	......	......	......	......
South Dakota	85	71	100	127	......	......	......	......	77	78	......	......
Nebraska	56	54	80	85	58	48	35	35	63	71	......	......
Kansas	24	48	100	60	32	50	25	40	44	68	......	......
Kentucky	55	52	70	56	46	53	65	45	82	78	......	......
Tennessee	42	53	65	49	37	50	38	47	77	71	......	......
Alabama	44	55	85	83	48	60	38	56	79	76	......	......
Mississippi	53	54	98	87	62	56	51	56	77	78	......	......
Louisiana	60	55	105	92	71	65	59	60	84	78	......	......
Texas	50	60	110	110	54	62	43	59	77	73	......	......
Oklahoma	42	61	93	78	40	54	40	60	65	67	......	......
Arkansas	55	54	75	70	48	49	60	56	82	70	......	......
Montana	81	84	125	106	70	80	......	......	80	......	......	......
Wyoming	90	75	150	......	......	......	......	......	......	......	......	......
Colorado	69	68	82	85	50	57	30	53	78	77	......	......
New Mexico	70	66	105	130	66	71	40	56	84	3	......	......
Arizona	78	76	160	200	81	83	81	72	92	84	......	......
Utah	83	76	100	89	74	67	79	70	92	86	......	......
Nevada	69	75	185	......	70	57	80	56	85	......	......	......
Idaho	83	76	92	100	83	75	71	62	94	86	......	......
Washington	73	80	95	80	78	82	81	73	90	88	......	......
Oregon	79	76	85	80	80	79	74	70	95	90	......	......
California	60	81	90	85	73	83	65	76	79	89	......	......
United States	47.7	54.4	75.2	67.5	59.1	65.3	47.6	53.6	75	83.3	76.3	77.1

[1] Production compared with a full crop.

TABLE 9.—*Vegetable crops: Forecast based upon returns to Sept. 1, with details, by States.*

States and Territories.	Potatoes.				Sweet potatoes, condition.		Tomatoes, condition.		Cabbages, condition.		Onions, condition.		Beans (dry), condition.	
	Condition.		Price.											
	Sept. 1, 1913.	10-year average.	Sept. 1, 1913.	5-year average.	Sept. 1, 1913.	10-year average.	Sept. 1, 1913.	7-year average.	Sept. 1, 1913.	7-year average.	Sept. 1, 1913.	7-year average.	Sept. 1, 1913.	7-year average.
	P. ct.	*P. ct.*	*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Maine	91	86	58	67	......	......	82	89	82	89	80	88	83	88
N. Hampshire	75	84	85	83	......	......	85	87	78	85	70	85	85	87
Vermont	83	83	83	88	......	......	81	88	85	88	83	90	88	87
Massachusetts	71	81	91	89	......	......	82	86	75	86	73	82	85	83
Rhode Island	73	81	81	92	......	......	86	84	80	83	78	81	87	79
Connecticut	69	79	87	93	......	......	84	88	78	87	76	83	80	84
New York	63	79	92	90	......	......	76	86	68	82	73	84	72	85
New Jersey	68	78	70	76	89	87	86	82	82	82	83	85	......	86
Pennsylvania	73	77	81	84	80	85	81	83	78	81	84	86	82	83
Delaware	73	79	72	78	91	86	80	77	80	82	81	85	92	......
Maryland	66	79	71	73	82	86	77	78	76	77	86	84	84	80
Virginia	84	83	76	76	87	86	84	80	79	81	89	87	84	80
West Virginia	67	83	90	87	85	84	83	82	83	82	91	88	83	84
North Carolina	79	83	71	79	90	87	85	82	79	80	89	88	88	83
South Carolina	76	80	140	116	86	86	81	81	76	80	86	85	82	80
Georgia	76	85	114	113	84	89	83	85	75	83	84	87	80	84
Florida	87	85	124	128	90	91	81	......	92	......	......	......	......	......
Ohio	59	76	96	88	78	84	83	85	75	86	81	87	77	85
Indiana	48	74	90	88	70	83	70	81	60	81	72	85	63	81
Illinois	44	76	90	84	60	83	62	86	50	81	63	86	52	82
Michigan	73	78	63	71	......	......	83	84	83	83	83	83	81	82
Wisconsin	83	80	45	67	......	......	91	85	89	81	90	82	89	85
Minnesota	83	80	41	63	......	......	90	83	88	81	89	84	91	85
Iowa	57	76	89	83	73	84	78	84	67	80	77	84	79	82
Missouri	47	75	97	85	42	80	40	80	28	73	54	82	33	77
North Dakota	78	83	54	73	......	......	81	76	83	77	80	80	84	80
South Dakota	76	84	72	80	......	......	73	79	73	78	75	82	79	82
Nebraska	53	76	85	87	50	82	53	76	50	72	66	78	66	79
Kansas	46	69	96	96	47	80	26	74	23	71	49	78	36	77
Kentucky	51	84	90	81	69	86	65	87	56	82	83	89	55	85
Tennessee	66	86	82	78	70	88	68	87	63	84	85	90	56	86
Alabama	77	86	109	107	80	89	86	84	78	81	85	87	73	84
Mississippi	76	83	99	109	80	89	84	83	76	77	85	85	76	82
Louisiana	75	80	81	92	87	90	74	82	71	77	80	84	75	82
Texas	60	73	92	112	64	74	75	73	75	67	80	79	75	75
Oklahoma	60	70	93	112	45	78	40	70	35	62	63	75	47	68
Arkansas	74	79	88	95	69	81	70	78	65	73	82	84	61	76
Montana	84	87	65	91	......	......	83	78	90	89	89	91	90	82
Wyoming	92	86	110	117	......	......	97	79	92	88	92	85	92	92
Colorado	78	83	78	99	85	......	85	82	86	88	85	89	84	86
New Mexico	49	80	150	120	78	76	72	75	76	82	82	84	68	83
Arizona	75	85	163	130	91	92	94	85	92	86	92	88	90	82
Utah	88	89	56	70	......	......	93	92	91	90	91	94	93	89
Nevada	96	94	85	115	......	......	90	81	91	90	93	93	95	......
Idaho	88	90	53	65	......	......	87	83	91	89	91	94	95	90
Washington	85	85	58	69	......	......	90	80	87	84	90	89	89	87
Oregon	93	85	55	69	......	......	94	83	93	89	93	91	97	89
California	78	89	65	79	89	92	85	90	86	90	90	92	82	89
United States	69.9	79.4	75.3	80.2	81.4	86.2	76.	81.2	74.2	81.7	78.8	85.2	79.2	84.2

TABLE 10.—*Miscellaneous crops: Forecast based upon returns to Sept. 1, with details, by States.*

States and Territories.	Clover seed.					Broom corn, condition.		Peanuts, condition.		Sugar beets, condition.		Sorghum, condition.		Tobacco, condition.	
	Acreage, per cent, of 1912.	Condition.		Price.											
		Sept. 1, 1913.	10-year average.	Aug. 15, 1913.	Aug. 15, 1912.	Sept. 1, 1913.	7-year average.	Sept. 1, 1913.	7-year average.	Sept. 1, 1913.	7-year average.	Sept. 1, 1913.	10-year average.	Sept. 1, 1913.	10-year average.
		P. ct.	*P. ct.*			*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Maine	100	.....	95	....	$10.80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
New Hampshire	.....	.....	.....	....	12.00	.....	.....	.....	.....	.....	.....	.....	.....	85	93
Vermont	100	.....	93	$13.00	9.00	.....	.....	.....	.....	.....	.....	.....	.....	75	88
Massachusetts	.....	.....	95	....	....	.....	.....	.....	.....	.....	.....	.....	.....	75	92
Rhode Island	.....	.....	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Connecticut	100	.....	92	....	12.00	.....	.....	.....	.....	.....	.....	.....	.....	75	93
New York	90	70	86	12.33	11.38	.....	.....	.....	.....	.....	84	.....	.....	72	86
New Jersey	87	77	82	....	12.67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pennsylvania	85	70	78	11.09	10.81	.....	.....	.....	.....	.....	.....	.....	.....	69	88
Delaware	90	79	86	10.00	7.60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Maryland	90	66	81	....	....	.....	.....	.....	.....	.....	.....	.....	.....	80	80
Virginia	100	88	84	12.10	11.40	82	81	90	80	.....	.....	83	81	89	83
West Virginia	87	88	86	12.00	12.71	.....	78	.....	.....	.....	.....	86	84	76	80
North Carolina	102	90	88	11.89	11.00	.....	.....	86	82	.....	.....	87	84	86	79
South Carolina	115	87	88	....	....	.....	.....	85	82	.....	.....	84	82	87	80
Georgia	92	.....	87	....	12.00	.....	.....	85	87	.....	.....	87	86	85	89
Florida	.....	.....	.....	....	....	.....	.....	89	88	.....	.....	88	84	90	87
Ohio	125	88	74	8.85	9.67	80	81	.....	.....	86	86	83	85	68	80
Indiana	112	83	78	8.63	8.71	.....	.....	.....	.....	83	.....	75	84	64	83
Illinois	110	78	83	9.17	9.10	66	80	.....	.....	81	86	63	84	62	86
Michigan	100	83	78	9.52	9.85	.....	.....	.....	.....	90	87	81	.....	.....	.....
Wisconsin	97	88	85	9.46	7.89	.....	.....	.....	.....	88	88	91	87	80	84
Minnesota	95	90	85	10.02	9.00	.....	.....	.....	.....	90	88	90	87	.....	.....
Iowa	110	89	83	9.92	8.87	80	86	.....	.....	87	.....	84	86	.....	.....
Missouri	105	71	82	10.11	10.00	48	79	.....	.....	.....	.....	48	84	45	82
North Dakota	110	.....	91	....	12.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
South Dakota	100	92	91	7.50	....	.....	.....	.....	.....	.....	.....	75	.....	.....	.....
Nebraska	100	78	87	11.33	11.20	60	83	.....	.....	70	89	59	85	.....	.....
Kansas	105	81	84	8.67	9.73	37	77	.....	.....	58	83	38	84	.....	.....
Kentucky	92	74	85	10.84	10.94	68	84	.....	.....	.....	.....	69	84	61	80
Tennessee	95	77	86	10.94	11.80	67	84	69	84	.....	.....	71	87	67	83
Alabama	200	90	89	....	....	70	83	84	87	.....	.....	81	84	87	87
Mississippi	105	79	87	....	....	70	89	84	85	.....	.....	81	82	.....	83
Louisiana	100	.....	91	....	....	.....	.....	85	90	.....	.....	84	89	82	84
Texas	120	71	80	....	....	66	78	73	80	.....	.....	75	80	65	82
Oklahoma	90	.....	.....	....	11.00	46	75	55	74	.....	.....	48	84	.....	.....
Arkansas	107	80	88	8.62	9.67	68	87	74	81	.....	.....	72	82	70	81
Montana	110	100	93	....	....	.....	.....	.....	.....	94	94	.....	.....	.....	.....
Wyoming	95	101	96	....	....	.....	.....	.....	.....	95	95	.....	.....	.....	.....
Colorado	110	100	87	....	....	62	83	.....	.....	89	92	77	84	.....	.....
New Mexico	105	97	.....	....	....	65	.....	53	74	84	80	66	81	.....	.....
Arizona	105	.....	.....	....	....	.....	.....	95	88	92	86	93	88	.....	.....
Utah	92	101	92	11.50	....	.....	.....	.....	.....	90	97	85	93	.....	.....
Nevada	.....	96	.....	....	9.90	.....	.....	.....	.....	96	.....	.....	.....	.....	.....
Idaho	96	97	94	8.20	10.00	.....	.....	.....	.....	97	91	.....	.....	.....	.....
Washington	85	95	96	....	12.00	.....	.....	.....	.....	95	91	.....	.....	.....	.....
Oregon	95	97	89	....	7.50	.....	.....	.....	.....	98	91	.....	.....	.....	.....
California	80	92	96	....	....	.....	.....	90	91	88	91	.....	91	.....	.....
United States	104.2	81.3	80.7	9.37	9.80	48.5	78.7	85.1	84.2	88.1	90.0	69.6	83.8	74.5	81.5

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USE OF CORN, KAFIR, AND COWPEAS IN THE HOME.

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Indian corn, Kafir corn, and cowpeas are important crops in the southern and southwestern United States. Of these, Indian corn is equally important in other regions of the country; cowpeas are grown and used almost exclusively in the Southern States, while Kafir corn is particularly well suited to warm regions where the rainfall is limited. The use of Kafir corn and of cowpeas as food for man might well become more general, as these, like Indian corn, rank high as sources of nutrients. This bulletin summarizes the results of some tests of the nutritive value of these three crops and ways of preparing them for the table.

INDIAN CORN.

Indian corn is peculiarly an American product, being native to American soil. It was originally a tropical or subtropical plant, but long before America was discovered the native inhabitants, by centuries of attempts to grow it in colder regions, had evolved varieties which would ripen as far north as Montreal—a wonderful accomplishment in agriculture, though achieved without definite plan or design. The ways of preparing it for human food are very numerous, and many of them, like the cereal itself, are of Indian origin.

COMPOSITION OF INDIAN CORN.

The varieties of Indian corn are many, white and yellow types being very common, red not uncommon, and even blue and black corn being found in the southwestern United States. There is a widespread popular belief that the food value of these different sorts varies as greatly as their color, but this is not the case. White, yellow, red, blue, and black corn are very much alike in composition, and are therefore equally valuable as sources of nourishment. They vary somewhat, however, in flavor. The liking for one or another is a personal or local matter.

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The average percentage composition of these various kinds of corn is as follows: Water, 10.8; protein, 10.0; fat, 4.3; starch, sugar, etc., 71.7; crude fiber, 1.7; and mineral matter, 1.5. The fuel value per pound is 1,795 calories.

COMPARISON OF DIFFERENT PARTS OF THE KERNEL.

The percentage composition of Indian corn as given above is that of the whole kernel as distinguished from any of its parts. A grain of corn is complex in structure, and its different parts vary greatly in nutritive value. For our purpose here it may be considered to consist of skin, germ, and endosperm. The skin constitutes about 6 per cent of the whole weight of the kernel; the germ, which contains the embryo, from which under favorable conditions new life will spring, constitutes about 10 per cent; and the endosperm, which is the storehouse of food for the new life, constitutes about 84 per cent. Of the total amount of crude fiber in a kernel of corn, 51 per cent is in the skin; of the starch, 90 per cent is in the endosperm; and of the protein, 80 per cent is in the endosperm and 16 per cent in the germ; while of the fat, 65 per cent is in the germ.

OLD AND NEW PROCESS MEALS COMPARED.

The older types of corn meal were usually ground between millstones turned by water power, and the term "water-ground corn meal" is still used in some regions. The skin was ground with the rest of the kernel and then partially removed by means of sieves and other devices. The newer types of meal are usually ground between cylinders, the equipment being much more elaborate than in the old mills. In the newer processes the corn is first kiln-dried, after which the outer skin can be easily removed in one piece. The germ is also easily separated, and after skin and germ are removed the corn is ground, bolted, and purified by air currents. The effect of removing the skin whole in the new process is to reduce very much the percentage of fiber; that of removing the germ, to reduce the protein and the fat. New-process meal, therefore, has somewhat less protein and a slightly lower fuel value, besides a smaller percentage of fiber, than the old-process meal.

The removal of the germ, which contains the corn oil, a substance peculiarly liable to become rancid, and the kiln-drying of the grain, which lessens or destroys molds and decay-producing bacteria, are not, however, without their advantages, for they have the effect of improving the keeping qualities of the meal. While the new-process meal, therefore, has a slightly lower nutritive value, pound for pound, than the old process, it is less liable to deterioration. It is sometimes said that the newer type of meal becomes much hotter in grinding than meal made by the older methods, and that for this or other reasons it does not possess so good a flavor as the old-fashioned meal; but those who have studied the subject carefully believe that any inferiority in dishes made from the new meal as compared with the old is due in part, at least, to the fact that cooks have not adjusted their methods to the changed character of the material.

A SPECIAL USE FOR CORN MEAL.

Corn meal, because of its lack of gluten, can not be made into light and porous breads except by the addition of eggs or of wheat, rye, Graham, or gluten flour, or in some similar way. The absence of gluten, which with water forms a sticky, tenacious mass, is responsible, however, for the fact that the meal retains much of its granular quality even after it has been mixed and heated with water. Dishes made with corn meal are likely to be more tender than those made with wheat, and the use of small amounts of corn meal in the making of such foods as waffles and doughnuts is to be recommended.

COMPOSITION OF CORN MEAL COMPARED WITH A BALANCED RATION.

In combining one food with others it is sometimes convenient to know how nearly it comes to being, in itself, a balanced ration, and also in what particulars it differs from such a ration. A pound of corn meal has a fuel value of 1,655 calories and contains 0.092 pound, or about 1.5 ounces, of protein or tissue-forming food. In the balanced ration for a person at moderate muscular work (as accepted by most authorities) the protein corresponding to a fuel value of 1,655 calories would be 0.118 pound, or 1.9 ounces. To each pound of corn meal on such a basis it is necessary to add 0.4 ounce of protein in order to make a ration in which tissue-forming material and fuel value are properly balanced. In the rational diet, therefore, corn meal is combined with foods which have more protein or less fat and carbohydrates than it has itself. Among such foods are milk, most kinds of meat and fish, eggs, and cheese. It is the common practice to eat corn-meal mush with milk, to add cheese to corn-meal mush which is to be fried, or to serve corn-meal preparations with meat. Fish balls with corn meal (for which a recipe is given on p. 5) is a dish which approximates the balanced ration.

COMPOSITION AND COST OF CORN MEAL COMPARED WITH OTHER PREPARED CEREALS.

The food values of the various kinds of corn meal average as follows: Water, 12.5; protein, 9.2; fat, 1.9; starch and sugar, 74.4; crude fiber, 1.0; and mineral matter, 1.0 per cent; and the fuel value per pound, 1,655 calories. For convenience this may be roughly stated in tenths, one-tenth being water, one-tenth protein, seven-tenths starch, the remaining tenth being divided among fat, fiber, and mineral matter in approximately equal amounts. So closely does the composition of corn meal resemble that of other prepared cereals that, pound for pound, they may all be considered to have the same food value. When corn meal or Kafir meal sells for 3 cents a pound, therefore, and some other cereal for 8 cents, the housekeeper may consider that she secures more than twice as much food for her family for a given sum when she selects corn or Kafir meal. When corn meal or Kafir meal is 3 cents a pound, and wheat flour is 5 cents, the corn or the Kafir has an advantage of about 50 per cent.

COOKING CORN MEAL.

A study of the modifications in methods of cooking which have been rendered necessary by changes in the composition of the meal was made at Teachers College, Columbia University, New York City, for the Office of Experiment Stations. The results of these investigations, which are still unpublished, may be summarized as follows: In general, 10 per cent more water is needed for the new-process meal than for the old-process, and where the large amount of water used renders the meal liable to sink (in breads, for example), the mixture of meal and water should be thoroughly heated before being used.

In experiments made in this office it was found that, when convenience as well as the final result is taken into consideration, it is best for almost every purpose to put the meal and cold water together and then heat them over boiling water in a double boiler. Except when very finely ground meals are used it is unnecessary to stir the mixture at any time, not even when the meal and water are put together. The conclusion has been reached, in fact, that in all cases—even those in which the liquid used is not water but either sweet or sour milk—the best results are obtained by heating the meal and liquid together without stirring. This applies to the making of corn-meal mush and also to more complicated dishes, such as breads.

The following recipes[1] illustrate some of the points brought out in the foregoing pages:

Sour Milk Corn Bread.

2 cupfuls corn meal.
2 cupfuls sour milk.
2 tablespoonfuls butter.
2 tablespoonfuls sugar, white or brown.
1½ teaspoonfuls salt.
2 eggs.
1 teaspoonful soda.
1 tablespoonful cold water.

Cook the meal, milk, salt, butter, and sugar in a double boiler for about 10 minutes. When the mixture is cool, add the eggs well beaten and the soda dissolved in the water. Bake in a shallow iron or granite pan for about 30 minutes.

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[1] All measurements are level.

CUSTARD CORN CAKE.

2 eggs.
¼ cupful sugar.
1 teaspoonful soda.
1 teaspoonful salt.
1 cupful sour milk.
1 cupful sweet milk.
1⅜ cupfuls corn meal.
⅛ cupful wheat flour.
2 tablespoonfuls butter.
1 cupful cream.

Beat the eggs and sugar together thoroughly. Sift the flour, soda, and salt together and mix them with the meal. Mix all the ingredients but the cream and butter. Melt the butter in a deep pan, using plenty on the sides. Pour in the batter, add (without stirring) a cupful of cream, and bake from 20 to 30 minutes. When cooked there should be a layer of custard on top of the cake, or small bits of custard distributed through it.

SPOON CORN BREAD.

2 cupfuls water.
1 cupful milk.
1 cupful white corn meal.
1 tablespoonful butter.
2 eggs.
2 teaspoonfuls salt.

Mix the water and the corn meal, and cook 5 minutes. Add the eggs, well beaten, and the other ingredients. Beat thoroughly and bake in a well-greased pan for 25 minutes in a hot oven. Serve from the same dish with a spoon.

CORN MEAL AND WHEAT WAFFLES.

1½ cupfuls water.
½ cupful white corn meal.
1½ cupfuls milk.
3 cupfuls wheat flour.
3 tablespoonfuls sugar.
1¼ tablespoonfuls baking powder.
1½ teaspoonfuls salt.
Yolks of 2 eggs.
Whites of 2 eggs.
2 tablespoonfuls melted butter.

Cook the meal in the water 20 minutes; add milk, the dry ingredients mixed and sifted, the yolks of the eggs well beaten, the butter, and the whites of the eggs beaten stiff. Cook on a greased waffle iron.

CORN MEAL FISH BALLS.

2 cupfuls cold white corn-meal mush.
1 cupful shredded codfish.
1 egg.
1 tablespoonful butter.

Pick over the codfish and soak it to remove salt, if necessary. Combine the ingredients and drop by spoonfuls into hot fat. Drain on porous paper. These codfish balls compare very favorably in taste with those made with potato and are more easily and quickly prepared.

INDIAN PUDDING.

5 cupfuls milk.
⅓ cupful Indian meal.
1 teaspoonful ginger.
½ cupful molasses.
1 teaspoonful salt.

Cook milk and meal in a double boiler 20 minutes; add molasses, salt, and ginger; pour into buttered pudding dish and bake 2 hours in slow oven; serve with cream.

KAFIR CORN.

Kafir corn was originally cultivated in South Africa, and takes its name from one of the native tribes. It was introduced into the United States in 1876. Because of its drought-resisting qualities it can be raised in localities too dry for the development of Indian corn. Up to this time it has been relatively little used for human food in the United States, though long a staple food in Africa, India, and China. In composition and digestibility, however, it differs little from Indian corn, as recent experiments in this office have shown. Its flavor is somewhat stronger, and while some people like it at once, others must acquire a taste for it.

THE COOKING OF KAFIR CORN.

Since Kafir corn resembles Indian corn closely in composition and nutritive value, it is unnecessary to treat of these subjects in detail here. Something, however, must be said about special precautions necessary in preparing it for the table. In making mush for use alone, or as a foundation for other dishes (yeast bread, gingerbread, etc.), the ingredients should be thoroughly mixed before being heated. Cooking should always be more thorough than for Indian corn. In making gingerbread with Indian meal, for example, it has been found sufficient to heat the meal and water for 10 minutes in a double boiler; but in making the same dish with Kafir meal it is necessary to cook the mush at least half an hour.

KAFIR CORN YEAST BREAD.

2 cupfuls Kafir corn meal.
2 cupfuls water.
2 tablespoonfuls sugar.
2 tablespoonfuls butter, lard, or other fat.
3 teaspoonfuls salt.
Wheat flour.
½ yeast cake (or 1 cake if haste is an object) dissolved in ¼ cupful of lukewarm water.

Cook the meal, sugar, salt, and water together in a double boiler for an hour; add the butter and cool. Stir in the yeast mixed with a little water. Add enough wheat flour to make a soft dough (about 1 cupful). Turn onto a board and mold thoroughly. Form into a loaf and put in a warm place to rise. When light, bake in a moderate oven.

KAFIR CORN GEMS.

1 cupful Kafir corn meal.
1¼ cupfuls buttermilk.
1½ tablespoonfuls butter.
1 tablespoonful sugar.
¾ teaspoonful salt.
1 teaspoonful ginger.
½ teaspoonful soda.

Cook the meal and the buttermilk together in a double boiler for a half hour or longer. While the mush is still warm, add the butter. When it is cool, add the other ingredients, dissolving the soda in about a tablespoonful of water. Bake in gem pans.

Kafir Corn Gingerbread.

2 cupfuls Kafir corn meal.
2½ cupfuls sour milk or buttermilk.
1 teaspoonful salt.
2 tablespoonfuls butter.
1 cupful wheat flour.
2 teaspoonfuls powdered ginger.
1 teaspoonful powdered cinnamon.
½ teaspoonful powdered cloves.
1½ teaspoonfuls soda.
¾ cupful sugar.
1 egg.

Mix thoroughly the meal, buttermilk, and salt in a double boiler, and cook over hot water one-half hour or longer. Stir the butter into the mush while it is still warm. Sift together the flour, spices, and soda. When the mush is cool combine all the ingredients. Beat thoroughly and bake in a moderate oven in shallow iron pans.

Doughnuts With Kafir Corn.

2 cupfuls milk, or milk and water.
1½ cupfuls Kafir corn.
1 teaspoonful salt.
¼ cupful butter.
¾ cupful sugar.
1¼ cupfuls wheat flour.
1 teaspoonful cinnamon.
2 teaspoonfuls baking powder.
2 eggs.

Heat the first three ingredients for a half hour or longer in a double boiler. Add the sugar and butter, and cool. Sift together the flour, cinnamon, and baking powder, and add to the cooled mush. Add the eggs well beaten and proceed as with other doughnuts.

Kafir Corn and Peanut Cookies.

2 tablespoonfuls butter.
¼ cupful sugar.
2 eggs.
1 teaspoonful baking powder.
¼ teaspoonful salt.
½ cupful Kafir corn.
2 tablespoonfuls milk.
½ cupful finely chopped peanuts.
1 teaspoonful powdered ginger.

Cream the butter, add the sugar and the eggs, and beat well. Mix and sift baking powder, salt, flour, and ginger, and add them to the first mixture. Add the milk and the peanuts, and again beat thoroughly. Drop the mixture from a teaspoon onto an unbuttered pan, bake 15 minutes in a slow oven. Or spread it in a very thin layer on the bottom of a dripping pan, bake in a slow oven, and while still warm cut into squares.

COWPEAS.

The cowpea is a member of a large botanical family known as the Leguminosæ, whose fruit or seeded pods are called legumes. It is said to be native to Africa,[1] and early in the eighteenth century was introduced into the United States by way of the West Indies. Gradually it spread northward and late in the century we have record of its cultivation as an experimental crop on George Washington's farm in Virginia. Because of the great length of time it requires to reach maturity, it can not be raised to mature its seed in the Northern States. In the South, however, it is cultivated extensively as a forage crop, for fodder, and also for human food. A large number of varieties with seeds of many shapes, sizes, and colors have been identified and named.[1]

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[1] U. S. Dept. Agr., Bur. Plant Indus. Circ. 124.

The cowpea is distinguished among the legumes for the peculiarly delicate and pleasing flavor of many varieties. It seems strange, therefore, that, though generally and favorably known as a staple food in the Southern States, it has not come into more general use in the dietary of the United States as a whole. Its failure to do so is probably attributable to the fact that no great effort has been made to create a general market for it. It is well worth very greatly extended use, as it is a wholesome, nutritious foodstuff from which a variety of palatable as well as economical dishes can be made.

Cowpeas are used on the table in three forms: In the pod, shelled green, and shelled dried. In these three forms they correspond, respectively, to string beans, shelled green peas, and dried navy beans, and call for much the same methods of preparation for the table.

COMPOSITION OF GREEN COWPEAS.

Green shelled cowpeas have the following percentage composition: Protein, 9.4; fat, 0.5; carbohydrates, 23; ash, 1.4. Their average fuel value per pound is 620 calories. Roughly speaking, and leaving out of account, for the moment, the small amount of fat and mineral matter, they are seven-tenths water, one-tenth protein, and two-tenths carbohydrates. In this unripe form they are naturally brought into comparison with other green vegetables. Even among the legumes they hold a high place, having an equally large amount of tissue-forming substances with green kidney beans, and more than peas or Lima beans. They have more than four times as much protein as an equal weight of potatoes, and nearly twice the fuel value. Tomatoes, green corn, asparagus, and carrots (four vegetables taken at random but nevertheless representative of green vegetables other than legumes and potatoes) have, on an average, less than one-fifth as much protein as cowpeas, and hardly a third of their fuel value. Even in its unripe form, therefore, the cowpea gives promise of those qualities which have led to its classification and use as a meat substitute.

COMPOSITION OF DRIED COWPEAS.

In the process of drying, the cowpea loses about four-fifths of its water. As the water decreases, protein increases from 9.4 to 21.4 per cent; fat, from 0.5 to 1.4 per cent; carbohydrates, from 23 to 60.8

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[1] U. S. Dept. Agr., Bur. Plant Indus. Bul. 229.

per cent; ash, from 1.4 to 3.4 per cent; and the fuel value, from 620 to 1,590 calories. In the dried form it is natural to compare the cowpea with the cereal grains because of its close physical resemblance to them. Such comparison, however, reveals little likeness in percentage composition. Eight of the common cereal grains—Indian corn, barley, Kafir corn, oats, rice, rye, buckwheat, and wheat—have on an average 10.7 per cent of protein, or less than half as much as dried cowpeas. In fact, so far as nutritive value is concerned, cowpeas and other legumes are not to be classed with vegetable foods but with meats and other animal products.

COMPOSITION OF COWPEAS AS COMPARED WITH THAT OF BEEF.

A side of beef averages 15.2 per cent protein; or, to put it in another way, every pound of such meat contains 2.4 ounces of protein. The fuel value per pound is 935 calories. A pound of dried cowpeas, on the other hand, contains 3.4 ounces of protein and has a fuel value of 1,590 calories. This comparison, however, loses much of its significance unless taken in connection with the digestibility of these two foods, which is considered in the next paragraph.

DIGESTIBILITY OF COWPEAS.

A few years ago extensive investigations upon the digestibility of legumes were made at the University of Tennessee in cooperation with this office.[1] In the course of this work, three varieties of cowpeas—the Whippoorwill, the Clay, and the Lady—were studied, and it was shown that 70, 74, and 83 (average 76) per cent, respectively, of the protein and 87, 88, and 95 (average 90) per cent of the carbohydrates were digested. These are very close to the figures for other vegetable foods, but much lower than those for meats, which have been shown to be about 98 per cent for both protein and fat.[2] By the use of these figures, it is easy to calculate that of the 3.4 ounces of protein in a pound of cowpeas, only 2.6 ounces is likely to be digested; while approximately all of the protein in a pound of beef (2.4 ounces) is digested. This brings the two food materials close together, so far as their value for tissue-formation is concerned, but leaves the fuel value of the cowpeas considerably in excess over the beef (about 1,300 or 1,400 as compared with 935 calories).

COST OF COWPEAS.

In regions where they are raised dried cowpeas are usually sold by the bushel, every bushel weighing about 50 pounds. In other places they are sold by the quart, which weighs somewhat over a pound and a half, the exact amount depending, of course, upon the size of the peas. If the housekeeper remembers these weights she has at hand the means of comparing roughly the cost of cowpeas with that of other foods at the prices current in her own district. When cowpeas sell for $1 per bushel, for example, their price per pound is 2 cents, and when they sell for 15 cents per quart their price per pound is about 10 cents. In either case they are much cheaper than meat at the usual prices.

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[1] U. S. Dept. Agr., Office Expt. Stas. Bul. 187.

[2] U. S. Dept. Agr., Office Expt. Stas. Bul. 193.

FOOD VALUE OF COWPEAS COMPARED WITH A BALANCED RATION.

In the balanced ration a food which contains 3.4 ounces of protein (as a pound of dried cowpeas does) should yield at least 3,000 calories. Cowpeas, therefore, which yield 1,590 calories for every 3.4 ounces of protein, need to be supplemented in the diet by foods which have a greater fuel value in comparison with their tissue-forming material. This indicates the reasonableness of the many combinations that are made with cowpeas: Cowpeas and rice, for example, to form "Hopping John"; cowpeas baked with salt pork; succotash; and salads, in which the peas are served with a dressing rich in oil, butter, or other fat.

METHODS OF COOKING COWPEAS.

As suggested above, cowpeas in the pod and also green shelled cowpeas, are usually cooked like string beans or ordinary green peas, in boiling salted water and served with a little butter, milk or cream. Precaution, however, should be taken not to gather or shell the green cowpeas long before they are to be cooked, for if this is done their fine flavor is likely to be greatly lessened. Dried cowpeas should be soaked over night or an equivalent length of time by day, and as they are likely to ferment they should be kept in a cool place. When soaked they double in volume and when boiled until tender they increase still further in size until every cupful of the dried peas has become nearly two and a half cupfuls of cooked peas. These figures may be helpful to cooks in changing the items in a receipt from raw to cooked peas, or vice versa.

It is a common practice in some places to remove the skin of the cowpeas after they have been soaked. This improves their appearance very much, for the interior portion is white in all varieties of the peas. It also, no doubt, renders them more completely digestible. It is, however, a most laborious process, particularly if the peas are of different varieties and consequently of different sizes. The skins are usually removed by rubbing the peas between the hands under water, and if some peas are smaller than the others, they are likely to escape without having their skins broken. This way of treating the peas is, therefore, not to be recommended except where very delicate dishes are desired for the use of invalids or for other purposes.

BAKED COWPEAS.

Cook 1 quart of large white cowpeas slowly in water until they begin to soften. This will require five or six hours. Put them into a bean pot, add one-half pound of salt pork, and 1 tablespoonful of molasses. Cover with water and bake slowly six or seven hours. It is well to have the pot covered except during the last hour.

HOPPING JOHN.

Soak 1 quart of dried cowpeas over night in water enough to cover. Cook until they are tender, adding more water if necessary. Cook a pint of rice in 3 pints of water, mix the two, season with 2 tablespoonfuls of butter and 2 teaspoonfuls of salt. A little beef or pork may be added to the water in which the peas are cooked.

COWPEA SOUP.

1 tablespoonful butter or pork fat.
1 tablespoonful finely chopped onion.
1 stalk celery, finely chopped.
1 cupful dried cowpeas.
Salt.

Soak the peas 8 or 10 hours in water enough to cover. Fry the vegetables in the butter, add the peas, in the water in which they were soaked, and cook (preferably in a double boiler) until the peas are tender. Put the mixture through a sieve and add water enough to bring it to the desired consistency. Reheat. If this soup is thickened with 1 tablespoonful of flour mixed with a little water, the pea pulp will be prevented from sinking.

CREAM OF COWPEA SOUP.

1 tablespoonful butter.
1 tablespoonful flour.
2 cups milk.
1 teaspoonful sugar.
1 cupful cooked cowpeas (green or dried).
A few drops of onion juice.
Salt.

Melt the butter, add the flour, and cook thoroughly, being careful not to brown it. Add the milk and bring the mixture to the boiling point. Put the peas through a sieve; add peas and seasonings to the milk and reheat. If too thick, add milk or water. Serve with croutons made by heating buttered bread in the oven until it is brown, and cutting it into small pieces.

COWPEAS WITH ROAST PORK.

When a roast of pork is nearly done, pour off most of the fat in the pan and add cowpeas which have been soaked and cooked until they are soft. Allow the pork fat to drip upon them, and cook until they are brown.

PURÉE OF PEAS.

Soak 1 pint of cowpeas in cold water over night. Cook until soft in just enough water to cover. Drain and pass through a sieve. Season with salt, pepper, ½ cupful of cream, and 2 teaspoonfuls of brown sugar. Or substitute milk for the cream and add a tablespoonful of butter. Beat thoroughly, reheat, and serve like mashed potatoes.

BAKED COWPEAS AND CHEESE: A MEAT SUBSTITUTE.

- 1 tablespoonful butter.
- 1 tablespoonful finely chopped onion.
- 1 tablespoonful finely chopped sweet green pepper.
- 2 cupfuls cooked cowpeas.
- ½ cupful grated cheese.

Press the peas through a sieve to remove the skins, and mix with the cheese. Cook the onion and pepper in the butter, being careful not to brown, and add them to the peas and cheese. Form the mixture into a roll, place on a buttered earthenware dish and cook in a moderate oven until brown, basting occasionally with butter and water. Serve hot or cold as a substitute for meat.

GREEN PEPPERS STUFFED WITH COWPEAS.

Cut sweet green peppers into two pieces lengthwise, remove all the seeds, and fill each piece with the mixture described in the above recipe. Place in a dish containing a small amount of butter and water. Bake in a moderate oven until the peppers are soft. Baste occasionally.

BAKED TOMATOES WITH COWPEAS.

Cut the tops from ripe tomatoes of uniform size, remove the pulp, and add it to the mixture described in the recipe for baked cowpeas and cheese. Salt the tomatoes on the inside and fill them with the cowpea mixture. Bake on a buttered dish until the tomatoes are soft.

SANDWICH FILLING.

The mixture of cooked peas and cheese may be used for a sandwich filling. In fact, cooked cowpeas mashed and freed from the skins by being put through a sieve may form the basis of a large variety of sandwich fillings. The cheese may be omitted and chopped celery or nuts added, or the peas may be mixed with a little butter and a few drops of vinegar or lemon juice. Leaves of lettuce dipped in salad dressing add to the attractiveness of the sandwiches.

COWPEA SALAD.

Mix cold cooked cowpeas with French dressing and serve on lettuce, endive, or water cress. The proportions for the French dressing are: 3 tablespoonfuls of salad oil, 1 tablespoonful of vinegar, and one-half teaspoonful of salt. Add a few grains of cayenne pepper.

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THE AGRICULTURAL OUTLOOK.

AGRICULTURAL FORECASTS.

GENERAL REVIEW.

The combined condition (or estimates of yields) of all crops on October 1 was about 13.6 per cent lower than their condition on October 1 last year and about 9.7 per cent lower than the average condition of crops on October 1 of recent years (mostly 10-year averages). As conditions on September 1 were 12.2 per cent lower than on September 1 last year and 10.1 per cent below the average year, it is seen that the month of September, as affecting crop prospects, was somewhat more favorable than the average September, though less favorable than September, 1912. Very good crop yields are indicated in Florida, Wisconsin, Minnesota, and Arizona, and very poor yields in Illinois, Missouri, Nebraska, Kansas, Kentucky, and Oklahoma.

The general level of farm prices of staple crops increased about 2.1 per cent from September 1 to October 1. This is an unusual increase, for during each September of the past five years the level of prices declined during September, the average decline for the five years being 3.8 per cent. The average level of prices of crops on October 1 was 8.1 per cent higher than on October 1 last year, 0.8 per cent higher than two years ago (a year of short crops), and 6.3 per cent higher than the average of the past five years on October 1.

The average farm price of meat animals on September 15 was about $7.15 per 100 pounds, which compares with $7.20 on August 15, $6.74 on September 15 a year ago, $5.87 two years ago, and $6.92 three years ago. From August 15 to September 15 the price level decreased 0.7 per cent, which compares with an increase of 2.7 per cent during the same period a year ago, unchanged two years ago, and an increase of 3.7 per cent three years ago.

General conditions of all crops, by States, as reported on Oct. 1 and Sept. 1. 100 represents the aggregate average crop prospects (not normal) of recent years (mostly 10 years).

State.	Oct. 1, 1913.	Sept. 1, 1913.	State.	Oct. 1, 1913.	Sept. 1, 1913.	State.	Oct. 1, 1913.	Sept. 1, 1913.
Maine	96.7	95.3	Ohio	95.0	96.5	Texas	98.5	95.1
New Hampshire	87.9	88.0	Indiana	93.5	93.7	Oklahoma	64.8	63.7
Vermont	96.3	96.1	Illinois	78.1	78.0	Arkansas	91.9	92.3
Massachusetts	94.9	100.2	Michigan	91.9	92.4	Montana	95.3	95.1
Rhode Island	99.1	97.2	Wisconsin	107.9	108.0	Wyoming	92.4	91.0
Connecticut	93.9	90.7	Minnesota	112.9	106.6	Colorado	90.2	89.9
New York	90.2	90.7	Iowa	99.6	101.9	New Mexico	83.6	83.5
New Jersey	97.3	96.4	Missouri	67.5	65.1	Arizona	116.4	114.3
Pennsylvania	95.3	96.2	North Dakota	91.3	95.4	Utah	89.9	88.5
Delaware	92.6	92.0	South Dakota	83.2	87.1	Nevada	104.4	103.5
Maryland	90.7	90.4	Nebraska	74.1	72.8	Idaho	100.8	100.2
Virginia	101.6	102.1	Kansas	58.8	58.7	Washington	101.4	102.7
West Virginia	88.5	89.5	Kentucky	76.6	74.9	Oregon	102.9	102.8
North Carolina	100.1	102.1	Tennessee	83.8	83.5	California	87.7	84.7
South Carolina	100.1	100.4	Alabama	95.5	92.4			
Georgia	99.7	98.0	Mississippi	95.1	92.9			
Florida	107.3	104.7	Louisiana	97.2	97.2	United States	90.3	89.9

THE CEREAL CROPS.

CORN.

The information gathered by the bureau indicated that the condition on October 1 was 65.3 per cent of a normal, compared with 82.2 in 1912 and a 10-year average of 80.6. This is an improvement of 0.9 per cent over the condition last month, and justifies a forecast of 22.2 bushels per acre, which compares with a yield of 29.2 in 1912 and an average of 26.5 for the years 1908–1912. This indicates a total production on the estimated area of 106,884,000 acres, which is only 0.2 per cent less than last year's record acreage, of approximately 2,373,000,000 bushels, compared with 3,124,746,000 in 1912 and 2,531,488,000 in 1911, being the lowest since 1903.

While generous rains have finally visited the drought-stricken portion of the corn belt, the moisture came too late to materially affect this year's crop.

The average price paid to producers on October 1 at local markets and shipping points was 75.3 cents, compared with 75.4 on September 1, 70.2 on October 1, 1912, and 67.3, the October 1 average for the five years 1908–1912.

The International Institute of Agriculture, on September 19, estimated a total production for 1913 of 2,766,000,000 bushels in nine countries, including those named below, being 22.4 per cent less than was produced in the same countries last year: United States, Hungary proper, Italy, Russia in Europe, Bulgaria, and Spain, the names being given in the relative order of importance in production. The crop of Hungary is estimated at 184,758,000 bushels; that of Italy at 98,422,000.

SPRING WHEAT.

The estimated yield per bushel based on the information gathered October 1 confirms the September 1 forecast of 13 bushels, which is much below the heavy yield of 17.2 last year, but only slightly under the five-year average of 13.3. Upon the previously estimated area of 18,663,000 acres, which is 3 per cent less than that of 1912, this indicates a production of 242,714,000 bushels, against last year's record crop of 330,348,000, and 190,682,000 in 1911.

WINTER WHEAT.

The winter wheat crop was estimated by the bureau on August 1 to be 511,000,000 bushels, the largest of record; the yield being 16.5, slightly exceeded by the record yield of 16.7 in 1906, and the acreage 30,938,000, which is 16.4 per cent greater than last year and second only to the acreage of 1903.

ALL WHEAT.

Combining the fair crop of spring wheat just harvested with the record winter-wheat crop gives a total production of 753,233,000 bushels, the largest ever grown in the United States, following a large crop of 730,267,000 in 1912, and a moderate crop of 621,338,000 in 1911. The estimated area devoted to the crop was 49,601,000 acres, exceeding the 1912 acreage by 8.3 per cent, and being the largest since 1901. The average yield is 15.2 bushels per acre, being 0.7 bushel below the 1912 yield but 0.7 above the average for the five years 1908–1912.

The average price paid producers October 1 was 77.9 cents, compared with 77.1 September 1; 83.4 on October 1, 1912; and 90.1 for the October 1 five-year average.

The International Institute of Agriculture on September 19 estimated the total production in 19 countries, the principal ones being mentioned below in order of importance of production, at 3,330,000,000 bushels, 4.1 per cent more than was produced in the same countries last year: Russia, United States, France, India, Canada, Italy, Hungary, Spain, Prussia, Roumania, Bulgaria, England and Wales, Algeria, Japan.

The Canadian Government's estimate of production, issued September 15, gives 192,517,000 bushels of spring wheat and 18,481,800 of fall wheat, a total of 210,998,800, compared with 199,236,000 in 1912 and 215,851,000 in 1911. The yield of spring wheat is placed at 21.41 bushels per acre.

OATS.

The yield of oats, according to the information gathered October 1, is 29.3 bushels per acre, much below last year's record yield of 37.4, but only slightly below the average of 29.7 for the years 1908–1912.

This indicates a total production on the previously estimated acreage of 38,341,000 acres, which is 1.1 per cent greater than last year and the largest ever devoted to this crop in the United States, of 1,122,139,000 bushels, compared with 1,418,337,000 last year and 922,298,000 in 1911. This year's crop, while modest compared with the extraordinary crop of last year, is the third largest in our history, the crop of 1910 holding second place.

An improvement of 5.4 per cent in prospective yield over that indicated by the condition reports of September 1 reflects the favorable weather conditions accompanying the harvesting of the crop and the frequent testimony to yields heavier than anticipated.

The average price paid producers October 1 was 39.6 cents, compared with 39.3 on September 1, 33.6 on October 1, last year, and an average of 40.1 for the same date in the years 1908–1912.

The International Institute of Agriculture estimated on September 19 a total production of 3,426,000,000 bushels in 17 countries, the important ones being named below in order of production, which is 5.9 per cent less than was produced in the same countries last year: Russia, United States, Prussia, Canada, Hungary, England and Wales, Denmark, Belgium, Italy, Roumania.

The Canadian crop was estimated by the Dominion Government on September 15 to be 395,341,000 bushels, against 361,733,000 in 1912; the yield being 40.98 bushels per acre and the area 9,646,400 acres.

BARLEY.

The indicated yield of barley, from the information collected by the bureau October 1, is 23.9 bushels per acre, which, while much below last year's figure of 29.7, which was the high record, is but slightly under the five-year average of 24.5. This average yield, on the previously estimated area of 7,255,000 acres, which is 3.7 per cent less than the 1912 acreage, indicates a total production of 173,301,000 bushels, against 223,824,000 in 1912 and 160,240,000 in 1911. This is an improvement of more than five million bushels over the forecast based on September 1 conditions, due partly to favorable weather conditions in the heavy barley region of the Dakotas, Minnesota, Wisconsin, and Iowa and partly to a better outturn at the threshings than was generally anticipated and reported at that time.

The average price paid producers on October 1 was 56.8 cents, compared with 55.2 on September 1, 54.8 on October 1, 1912, and an average of 60.3 on the same date for the years 1908–1912.

The International Institute of Agriculture on September 19 estimated the total production of barley in 17 countries, including the important ones named below in order of importance of production, at 1,225,000,000 bushels, which is 1.2 per cent more than was produced in the same countries last year: Russia, United States, Japan, Prussia, Hungary, Spain, Algeria, England and Wales, Canada, Roumania, Denmark.

The Canadian Government's estimate of September 15 gives an average yield of 31.05 bushels and a total production of 44,440,000 bushels, compared with 44,014,000 bushels in 1912.

RYE.

The yield of rye, previously estimated, is 16.3 bushels per acre, the area 2,134,000 acres, and the total production 34,789,000 bushels, against 35,664,000 bushels in 1912.

The average price paid producers October 1 was 64.8 cents, compared with 63 cents September 1, 70.1 on October 1, 1912, and an average of 73.9 on that date for the years 1908–1912.

The International Institute of Agriculture, on September 19, estimated a total production in 14 countries, including the important ones named below in order of relative production, of 1,496,000,000 bushels, which is 6.7 per cent less than was produced in the same countries last year: Russia, Prussia, Hungary, France, United States, Spain, Belgium, Denmark.

The Canadian report of September 15 gives 2,425,000 bushels on 127,200 acres, against 2,594,000 last year.

BUCKWHEAT.

The information gathered by the bureau, October 1, indicates a condition of 65.9 compared with 89.2 in 1912, and a 10-year average of 84.2, which justifies the forecast of a yield of 16.5 bushels compared with 22.9 in 1912 and 21 in 1911. This indicates a total production on the planted area of 841,000 acres (which is the same as last year) of approximately 14 million bushels, the smallest crop since 1900, following the record crop of 19 million in 1912 and the large crops of almost 18 million in 1911 and 1910.

This shows a decrease during September of 6.7 per cent in the prospects of total production of this crop, following a similar decrease of 11.8 per cent during August, due in August to drought and in September to killing frosts during the second week of the month, in the heavy producing States of New York and Pennsylvania.

The price paid producers October 1 was 74.1 cents, compared with 70 on September 1, 69.7 on October 1, 1912, and a five-year average on that date of 72.6.

RICE.

The information gathered by the bureau on October 1 shows a condition of 80.3, compared with 89.2 in 1912 and a 10-year average of 87.5, which justifies the forecast of a yield of 30.9 bushels per acre, compared with 34.7 in 1912 and 33.7 in 1911, and a total production upon the previously estimated area of 824,100 acres, which is the largest yet planted and an increase of 14 per cent over the area in 1912, of approximately 25 million bushels, about equaling last year's record crop and being 2 million larger than in 1911. This promised production is 2 million bushels, or 7.4 per cent, less than forecasted September 1, the loss during September being due to rain and flood damage in Arkansas, Louisiana, and Texas, particularly in the latter State.

The International Institute of Agriculture gives the estimated production for Japan at 16,662,000,000 pounds, an increase of 5.1 per cent over the crop of last year.

FLAXSEED.

The information gathered by the bureau shows a condition October 1 of 74.7 per cent, compared with 83.8 in 1912 and a ten-year average of 78.5, justifying the forecast of a yield of 8.7 bushels per acre, which is below the 9.8 yield of 1912 but above the five-year average of 8.2. This indicates a total production upon the previously estimated area of 2,425,000 acres, which is 14.9 per cent less than the area in 1912, of approximately 21 million bushels, against the large production of 28 million in 1912, the low production of 19 million in 1911, and the very low figure of 13 million in 1910.

The average price paid producers October 1 was $1.23, compared with $1.28 on September 1, $1.48 on October 1, 1912, and a five-year average of $1.63.

The Canadian crop is reported at 15,168,000 bushels, against 21,681,500 bushels in 1912. The Russian crop has not yet been estimated, but is generally reputed to be somewhat less than that of last year. The British Indian crop for 1913 is reported by the International Institute of Agriculture as 83.4 per cent of the crop of 1912.

OTHER CROPS.

COTTON.

The condition of the cotton crop September 25, viz, 64.1 per cent of normal, was the lowest condition estimate for that date with one exception (1909) in the past 10 years. It has been reported lower than this amount five times in the past 30 years.

From August 25 to September 25 the condition declined from 68.2 per cent of normal to 64.1 per cent of normal, or 4.1 points. This compares with an average decline from August 25 to September 25 in the past 10 years (1903–1912) of 6.1 points; that is, from 74.7 per cent of normal August 25 (1903–1912) to 68.6 per cent of normal September 25 (1903–1912). Thus the condition, which was 91.3 per cent of the 10-year *average* condition on August 25, was 93.4 per cent of *average* condition on September 25.

During August the drought which was so disastrous to conditions previously was completely broken. Rains have covered the entire cotton belt, but too late in many sections to be of much, if any, benefit to the crop; indeed various comments indicated some damage resulting from the storms, the rainfall being excessive in some places. Particularly, the grade of the staple has been adversely affected in the eastern part of the belt more than usual. Complaint of damage from anthracnose was made.

The condition on September 25 was such as to indicate smaller total production than in 1911 and 1912, but, owing to the large acreage, larger production than in any year preceding these two years, with the probable exception of the crop years of 1904, 1906, and 1908.

Cotton: Acreage, condition, price per pound, and amount ginned.

State.	Preliminary area 1913 (000 omitted).	Condition Sept. 25.			Condition Aug. 25.	Price per pound Oct. 1.			Price per pound Sept. 1.	Ginned prior to Sept. 25 census (000 omitted).		
		1913	1912	10-year average.		1913	1912	5-year average.		1913	1912	1911
	Acres.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Bales.*	*Bales.*	*Bales.*
Virginia	50	75	70	76	80	......	11.1	11.4	......	......	......	......
North Carolina	1,560	70	70	73	78	13.2	11.3	11.3	11.8	50	102	156
South Carolina	2,716	71	68	72	77	13.3	11.2	11.2	11.7	192	174	338
Georgia	5,336	72	65	72	76	13.3	11.1	11.2	11.7	491	272	766
Florida	230	78	65	71	81	13.7	13.5	14.2	14.0	16	10	22
Alabama	3,804	67	68	69	72	13.3	11.1	11.2	11.6	323	192	360
Mississippi	3,045	63	63	67	69	13.3	11.4	11.5	12.0	120	57	97
Louisiana	1,166	60	69	63	67	13.1	11.2	11.1	11.8	77	74	89
Texas	11,732	63	75	66	64	13.3	11.2	11.2	11.9	1,727	2,003	1,668
Arkansas	2,117	63	68	69	72	13.2	11.4	11.4	11.7	70	41	44
Tennessee	823	68	68	74	80	13.4	11.3	11.2	11.8	18	1	16
Missouri	113	64	72	76	72	13.0	11.3	11.1	11.6	......	......	......
Oklahoma	2,916	42	69	69	45	13.1	11.1	11.0	11.7	149	77	116
California	14	100	90	93	96	......	......	......	......	......	......	......
United States	35,622	64.1	69.6	68.6	68.2	13.3	11.2	11.3	11.8	3,238	3,007	3,677

VEGETABLES.

Although the breaking of the drought by general rains during September helped late vegetables in the Central States, general prospects have not been materially changed during the month. The potato prospect has been reduced slightly, from 325,000,000 bushels indicated on September 1 to 319,000,000 indicated on October 1; this reduction is due mostly to damage from frost in New York. All surplus potato States except Maine and Colorado indicate materially smaller production than last year, the total crop indication being about 25 per cent less than last year. Onions and cabbages also will be materially less than last year, particularly in the surplus States. Last year prices for these products had a sagging tendency as the season advanced. So far as supply is a factor, much higher prices might be expected this year. This crop season is somewhat comparable with the crop season of 1911, when production was also short.

Estimated average prices to producers of the United States on dates indicated.

Year.	Potatoes, per bushel.			Onions, per bushel.			Cabbages, per 100 pounds.		
	Oct. 1.	Jan. 1.	Apr. 1.	Sept. 15.	Dec. 15.	Mar. 15.	Sept. 15.	Dec. 15.	Mar. 15.
1911-12	$0.88	$0.85	$1.17	$1.04	$1.13	$1.67	$1.94	$1.83	$2.88
1912-13	.51	.51	.50	.89	.84	.77	1.25	1.15	1.03
1913	.74	....	....	1.04	....	....	1.79	....	....

SUGAR CANE.

The condition of this crop on October 1 was estimated at 85.3 per cent of normal, compared with 84.9 on September 1, 78.9 on October 1 last year, and 86.3, the average of the past 10 years on October 1. It thus appears that the prospect is moderately below average. This crop is confined almost entirely to Louisiana.

HEMP.

The growth of this crop is confined mostly to central Kentucky, in which State the production is estimated at 55 per cent of a full crop, or about 69.1 per cent of an average production of recent years. The yield per acre is estimated at 855 pounds, against 950 pounds last year.

SUBTROPICAL FRUITS AND NUTS.

The condition of subtropical fruits and nuts in California declined slightly during September and promises on the whole below average production. Prospects in Florida, however, are good.

Condition of subtropical fruits and nuts in California and Florida on Oct. 1.

	California.			Florida.		
	1913	1912	1911	1913	1912	1911
Apricots[1]	61	80	75	....	....	....
Almonds	53	83	65	....	....	....
Prunes[1]	63	88	80	....	....	....
Olives	73	74	90	....	....	....
Walnuts	75	86	86	....	....	....
Grapes:						
Wine[1]	76	87	85	....	....	....
Raisin	75	89	87	....	....	....
Table	83	87	88	....	....	....
Oranges	76	87	93	88	100	75
Lemons	65	89	94	....	95	73
Grapefruit	....	....	....	82	100	56
Limes	....	....	....	88	92	78

[1] Production compared with a full crop.

Corn and wheat crops: Estimates and forecasts based upon returns October 1, with details, by States.

State.	Corn.						Spring wheat.				All wheat.					
	Condition.		Production (in millions).		Price.		Yield per acre.		Production (000 omitted).		Production (000 omitted).		Quality.		Price.	
	Oct. 1, 1913.	Average.	Forecast, 1913.[1]	1912.	Oct. 1, 1913.	Oct. 1, 1912.	1913.	Average.	1913.	1912.	1913.	1912.	1913.	Average.	Oct. 1, 1913.	Oct. 1, 1912.
	P.c.	*P.c.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*P.c.*	*P.c.*	*Cts.*	*Cts.*
Maine	62	83	0.5	0.6	90	91	25.5	24.6	76	70	76	70	....	94	100	....
N. Hampshire	65	85	.7	1.1	83	87	....	....	....	....	....	....	....	....	....	....
Vermont	70	84	1.5	1.8	84	85	24.5	24.0	24	25	24	25	....	90	100	100
Massachusetts	72	86	1.7	2.1	80	91	....	....	....	....	....	....	....	....	....	....
Rhode Island	82	90	.4	.5	106	110	....	....	....	....	....	....	....	....	....	....
Connecticut	75	88	2.3	3.0	88	80	....	....	....	....	....	....	....	....	....	....
New York	58	80	13.8	19.8	84	81	....	....	....	....	6,700	5,360	....	92	92	100
New Jersey	83	84	9.7	10.4	85	84	....	....	....	....	1,408	1,462	....	94	94	99
Pennsylvania	78	84	55.0	61.6	83	78	....	....	....	....	21,862	22,320	....	92	90	93
Delaware	79	86	5.9	6.6	68	90	....	....	....	....	1,638	1,942	....	89	84	100
Maryland	80	85	23.4	24.5	77	84	....	....	....	....	8,073	8,985	....	91	88	93
Virginia	85	85	50.7	47.5	85	90	....	....	....	....	10,064	8,596	....	90	95	102
West Virginia	81	82	22.0	24.5	85	84	....	....	....	....	2,957	3,378	....	91	96	102
N. Carolina	85	84	53.2	51.1	96	94	....	....	....	....	7,055	5,322	....	90	104	109
S. Carolina	85	82	34.0	34.3	103	104	....	....	....	....	972	727	....	86	121	126
Georgia	87	86	56.8	54.0	96	95	....	....	....	....	1,732	1,228	....	87	121	124
Florida	98	86	9.3	8.5	80	88	....	....	....	....	....	....	....	....	....	....
Ohio	80	84	147.0	174.4	72	71	....	....	....	....	34,326	9,760	....	88	89	98
Indiana	80	85	175.1	199.4	71	68	....	....	....	....	39,534	10,080	....	87	87	95
Illinois	61	84	284.3	426.3	71	66	....	....	....	....	41,963	9,819	....	90	85	92
Michigan	80	82	54.0	55.2	71	75	....	....	....	....	12,714	7,000	....	90	87	100
Wisconsin	94	84	63.9	58.3	63	64	18.6	16.3	1,916	1,868	3,665	3,564	....	88	83	85
Minnesota	99	83	90.2	78.2	61	57	16.2	13.4	67,959	67,038	67,959	67,038	....	87	77	80
Iowa	77	82	323.0	432.0	66	61	17.0	14.7	5,644	5,950	13,460	12,850	....	91	77	81
Missouri	44	80	122.3	243.9	78	66	....	....	....	....	39,580	23,750	....	90	84	92
North Dakota	90	77	9.8	8.8	53	50	10.5	11.8	79,695	143,820	79,695	143,820	....	87	74	75
South Dakota	79	84	70.6	76.3	61	54	9.0	12.0	33,075	52,185	33,075	52,185	....	88	73	72
Nebraska	39	78	102.8	182.6	71	62	12.0	12.8	3,576	4,202	61,682	55,052	....	93	73	74
Kansas	10	69	23.8	174.2	79	66	8.5	10.8	442	840	86,957	92,290	....	91	80	77
Kentucky	60	86	74.5	109.4	86	77	....	....	....	....	9,765	6,860	....	86	94	99
Tennessee	66	85	66.9	88.3	84	80	....	....	....	....	8,208	7,077	....	87	96	120
Alabama	78	86	48.3	54.2	99	93	....	....	....	....	374	318	....	86	120	129
Mississippi	81	83	56.5	56.8	85	83	....	....	....	....	126	96	....	86	125	100
Louisiana	84	82	30.9	32.5	82	67	....	....	....	....	....	....	....	....	....	....
Texas	78	73	155.3	153.3	82	66	....	....	....	....	11,812	11,025	....	84	92	88
Oklahoma	38	67	64.2	101.9	75	55	....	....	....	....	16,380	20,096	....	87	83	77
Arkansas	70	80	45.7	50.5	80	73	....	....	....	....	1,262	940	....	86	89	91
Montana	90	84	.9	.6	65	80	21.5	25.2	7,762	7,708	21,023	19,346	....	93	63	62
Wyoming	90	86	.4	.4	70	50	25.0	25.8	1,200	1,285	2,000	2,181	....	93	70	76
Colorado	66	82	7.4	8.7	75	70	21.0	25.2	5,670	6,240	10,122	10,968	....	90	75	74
New Mexico	61	82	1.7	2.1	110	77	19.0	21.4	494	572	1,219	1,232	....	90	97	80
Arizona	79	88	.5	.5	100	118	24.5	25.1	49	56	913	707	....	92	112	94
Utah	92	92	.3	.3	63	80	28.0	26.9	2,156	2,219	6,066	6,059	....	94	68	70
Nevada	98	91	....	....	....	....	31.0	29.5	775	725	1,097	1,137	....	97	97	106
Idaho	90	91	.4	.4	75	80	28.0	24.6	4,984	4,952	14,053	14,566	....	95	65	66
Washington	80	88	.9	.8	85	85	19.0	19.6	23,161	26,459	52,159	53,728	....	93	71	71
Oregon	95	89	.6	.6	68	95	19.5	17.9	4,056	4,134	15,655	21,018	....	95	73	73
California	80	88	1.4	1.9	86	93	....	....	....	....	3,822	6,290	....	92	91	88
U. S.	65.3	80.6	2,374.1	3,124.7	75.3	70.2	13.0	13.5	242,714	330,348	753,233	730,267	....	90.2	77.9	83.4

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[1] Forecast based upon condition report Oct. 1.

Oats and barley crops: Estimates based upon returns Oct. 1, with details by States.

States.	Oats.								Barley.							
	Yield per acre.		Production (000 omitted).		Quality.		Price.		Yield per acre.		Production (000 omitted).		Quality.		Price.	
	1913.	Average.	1913.	1912.	1913.	Average.	1913.	1912.	1913.	Average.	1913.	1912.	1913.	Average.	1913.	1912.
	Bu.	*Bu.*	*Bu.*	*Bu.*	*P.c.*	*P.c.*	*Cts.*	*Cts.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*P.c.*	*P.c.*	*Cts.*	*Cts.*
Maine	40.0	37.5	5,440	4,602	96	94	54	52	28.5	29.3	114	105	94	93	81	75
N. Hampshire	34.8	34.2	418	468	92	93	58	54	28.0	23.4	28	28	91	91	90	93
Vermont	38.5	37.2	3,042	3,311	94	92	58	57	32.0	31.5	416	455	93	93	82	89
Massachusetts	35.0	33.5	280	272	85	91	56	70	....	....	....	....	....	....	....	....
Rhode Island	26.0	29.0	52	57	84	89	45	....	....	....	....	....	....	....	....	....
Connecticut	28.0	32.8	308	338	86	93	57	54	....	....	....	....	....	....	....	....
New York	33.5	31.8	43,114	36,714	94	89	47	42	26.7	26.0	2,056	2,132	94	90	71	73
New Jersey	29.0	29.5	1,972	1,849	88	87	46	50	....	....	....	....	....	....	....	....
Pennsylvania	31.0	30.3	35,774	36,377	90	87	47	42	26.0	24.6	182	192	93	91	68	77
Delaware	30.5	28.6	122	122	88	85	46	....	....	....	....	....	....	....	....	....
Maryland	28.0	26.9	1,260	1,350	87	87	46	46	29.0	28.6	116	108	69	92	70	70
Virginia	21.5	19.3	4,020	3,885	90	86	51	54	26.0	26.8	260	250	94	93	75	71
W. Virginia	24.0	22.8	2,664	3,108	89	86	52	50	....	....	....	....	....	....	....	....
N. Carolina	19.5	16.1	4,251	3,794	89	85	61	64	....	....	....	....	....	....	....	....
S. Carolina	23.5	19.0	8,225	6,966	90	86	68	69	....	....	....	....	....	....	....	....
Georgia	22.0	17.2	8,976	7,571	88	88	65	68	....	....	....	....	....	....	....	....
Florida	18.0	14.4	810	740	82	84	67	73	....	....	....	....	....	....	....	....
Ohio	30.2	33.5	55,055	93,280	89	87	40	33	24.0	27.5	456	620	88	88	56	58
Indiana	21.4	29.7	37,471	79,799	77	86	39	30	25.0	25.9	200	266	85	89	45	59
Illinois	23.8	31.8	102,435	182,726	78	86	39	30	26.0	29.0	1,378	1,796	88	90	58	57
Michigan	30.0	30.8	45,450	51,826	91	87	41	34	24.8	25.1	2,108	2,262	91	88	64	64
Wisconsin	36.5	32.9	83,768	84,746	95	86	39	32	25.0	28.0	20,075	24,843	85	85	58	57
Minnesota	37.8	31.4	112,531	122,932	93	85	34	26	24.0	24.8	33,984	42,018	84	83	54	44
Iowa	34.5	30.8	168,326	217,818	94	87	36	27	25.0	26.2	11,050	14,570	87	86	60	53
Missouri	21.2	24.4	26,246	37,125	78	83	43	33	22.0	22.9	132	149	84	87	....	....
N. Dakota	25.7	28.8	57,928	95,220	89	88	32	24	20.0	21.7	22,340	35,162	86	83	48	39
S. Dakota	26.5	29.5	42,294	52,390	88	87	34	26	17.5	23.7	16,765	23,062	84	84	53	44
Nebraska	26.5	25.4	60,288	55,510	89	85	38	30	16.0	22.7	1,760	2,486	87	84	50	37
Kansas	19.5	24.0	36,894	55,040	80	82	46	38	8.1	19.3	1,426	4,136	80	84	54	41
Kentucky	19.8	21.8	3,128	4,035	83	84	52	45	26.6	24.5	80	78	90	87	....	....
Tennessee	21.0	20.7	6,069	5,599	89	86	53	49	25.0	23.3	50	52	92	88	85	92
Alabama	20.5	17.4	5,863	5,200	87	85	67	66	....	....	....	....	....	....	....	....
Mississippi	20.0	17.7	2,600	1,966	85	82	62	62	....	....	....	....	....	....	....	....
Louisiana	22.0	18.5	748	707	83	83	56	52	....	....	....	....	....	....	....	....
Texas	32.5	29.6	29,250	31,140	83	80	48	40	24.5	24.2	147	176	82	86	65	71
Oklahoma	20.0	26.2	20,600	23,494	76	81	46	35	9.0	23.8	72	160	72	85	70	50
Arkansas	26.5	21.3	5,088	3,482	82	80	53	52	....	....	....	....	....	....	....	....
Montana	43.5	44.6	22,359	22,848	95	94	34	33	31.0	34.6	1,333	1,424	92	93	60	51
Wyoming	38.0	35.6	8,588	8,569	98	94	43	33	31.0	31.0	372	374	97	94	59	55
Colorado	35.0	37.6	10,570	12,412	92	94	45	42	32.5	35.8	2,470	2,964	90	92	57	45
New Mexico	30.0	31.9	1,680	1,839	90	92	75	40	24.0	29.6	72	70	88	92	60	73
Arizona	43.0	36.0	258	268	93	93	55	82	39.0	37.9	1,326	1,440	96	94	70	74
Utah	46.0	43.2	4,094	4,222	96	96	39	43	38.5	40.5	962	1,125	96	96	56	54
Nevada	43.0	39.9	430	400	96	97	47	60	41.0	37.0	533	492	99	97	82	74
Idaho	46.5	43.1	16,182	17,017	98	95	41	33	42.0	39.7	6,930	6,916	95	96	57	60
Washington	47.5	47.8	13,775	13,689	95	93	40	43	40.0	36.9	7,400	7,869	95	93	55	55
Oregon	42.3	32.8	15,186	13,714	98	92	35	39	35.0	33.2	4,130	4,284	96	93	55	56
California	31.6	33.7	6,257	7,800	89	91	55	52	26.0	26.5	32,578	41,760	84	91	66	69
U. S.	29.3	29.8	1,122,139	1,418,337	89.1	87.1	39.6	33.6	23.9	25.5	173,301	223,824	86.4	87.0	56.8	54.8

Miscellaneous grain crops: Estimates based upon returns Oct. 1, with details by States.

State.	Buckwheat.		Flaxseed.		Rice.		Clover seed.	Alfalfa seed.				Kafir corn.		Millet.			
	Condition Oct. 1.		Condition Oct. 1.		Condition Oct. 1.		Condition.	Yield per acre.		Production.[1]		Production.[1]		Production of hay.[1]		Production of seed.[1]	
	1913.	Average.	1913.	Average.	1913.	Average.	1913.	1913.	1912.	1913.	1912.	1913.	Average.	1913.	Average.	1913.	Average.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Bu.*	*Bu.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Me.	85	89					100							75	88		
N. H.	84	91					85							83	82		
Vt.	78	89					100							90	91		
Mass.	71	86					68							83	88		
R. I.														82			
Conn.	77	90					90							83	92		
N. Y.	52	83					81			78				67	86	63	81
N. J.	80	83					80			89	100			66	88	63	86
Pa.	68	85					55			89	92			74	86	80	77
Del.	80	84					70							76		100	
Md.	80	88					65							81	80	84	73
Va.	82	87					75	3.5	3.5	82	83			82	83	79	79
W. Va.	80	86					82			80	90			84	83	82	83
N. C.	85	90			80	83	84							86	86	84	84
S. C.					80	78								85	81	86	80
Ga.					81	86	75							84	85	77	82
Fla.					88	85											
Ohio.	74	83					80	2.5	3.2	90	82			75	84	77	79
Ind.	80	83					80	2.0	2.3	82	83			70	84	73	79
Ill.	80	85					69	2.5	4.0	80	84	68	84	64	86	65	82
Mich.	75	80					82	2.9	2.6	90	82			84	82	81	76
Wis.	84	82	87	85			83	3.5	5.5	87	79			95	84	92	81
Minn.	81	84	73	82			83	2.5	3.5	85	82			89	85	82	81
Iowa.	80	83	89	86			85	3.6	3.0	90	86			85	86	85	82
Mo.	57	83	47	74			65	2.5	3.0	79	80	53	82	47	82	42	77
N. Dak.			74	76			86	3.5	3.0	100	99			80	78	75	74
S. Dak.			70	83			79	2.7	3.0	90	81			80	84	75	80
Nebr.	58	85	80	85			75	3.6	2.9	100	80	48	81	62	82	61	79
Kans.	69	78	67	71			70	3.9	2.8	95	73	35	84	30	78	50	72
Ky.							73	5.0	5.8	85	78			66	83	64	77
Tenn.	76	87					72			80	92			65	85	64	79
Ala.					87	84	80			100	105			78	85	77	78
Miss.					81	82	90			92	89			85	82	70	82
La.					80	87	92	2.5	2.0	50	40			84		80	
Tex.					79	90	90	4.5	5.7	75	85	67	76	65	72	58	69
Okla.			68	78			81	3.7	3.2	85	81	52	81	57	75	53	72
Ark.					85	90	71	2.4	1.4	75	82	75	78	70	78	74	76
Mont.			80	86			87	4.4	4.3	98	100			95	89	100	61
Wyo.							97	3.7	4.2	88	93			80	86	85	78
Colo.			48				90	3.8	3.2	80	90	80	89	70	81	70	75
N. Mex.								4.0	6.0	85	88	68	78	67		60	
Ariz.								5.0	5.6	88	90	100	89	90		100	
Utah.							100	5.5	7.0	87	83			82	94	90	97
Nev.							98			95	95						
Idaho.							93	5.0	5.0	88	90						
Wash.							95	4.3	4.5	90	100						
Oreg.							95	4.2	4.3	80	97						
Cal.					95		95	5.4	5.8	82	90	87	91				
U.S.	65.9	84.2	74.7	78.5	80.3	87.5	76.1	4.2	4.6	89.4	84.2	55.1	83.0	61.8	80.9	62.1	76.6

[1] Production compared with a full crop.

Fruit crops: Estimates based upon returns Oct. 1, with details by States.

State.	Apples.					Pears.		Grapes.		Cranberries.		Tomatoes.	
	Condition Oct. 1.			Price.		Condition Oct. 1.		Condition Oct. 1.		Condition Oct. 1.		Production.[1]	
	1913	1912	Average.	Sept. 15, 1913.	Sept. 15, 1912.	1913	Average.	1913	Average.	1913	Average.	1913	Average.
	P. ct.	*P. ct*	*P. ct.*	*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Maine	47	75	66	75	55	65	77	70	93	73	74	83	86
New Hampshire	40	75	61	96	65	75	81	69	89	......	......	76	88
Vermont	24	74	63	105	60	80	82	72	85	......	......	70	90
Massachusetts	55	76	64	100	80	91	76	86	83	76	73	79	87
Rhode Island	72	63	61	100	100	98	78	88	79	85	74	81	89
Connecticut	70	65	63	60	72	95	76	83	79	68	80	80	90
New York	34	73	59	75	50	83	71	60	83	62	79	68	87
New Jersey	57	47	57	63	60	58	68	74	84	61	75	86	85
Pennsylvania	43	53	61	78	56	57	70	55	78	......	......	80	83
Delaware	40	70	61	55	55	27	65	68	81	......	......	87	79
Maryland	41	70	65	100	50	35	67	60	78	......	......	80	78
Virginia	34	85	58	65	42	29	59	68	75	......	......	84	80
West Virginia	12	89	55	105	41	12	62	40	69	......	......	83	83
North Carolina	35	74	57	75	65	31	59	76	78	......	......	80	82
South Carolina	30	62	56	115	100	34	66	77	75	......	......	81	79
Georgia	45	60	53	85	80	42	63	78	77	......	......	84	83
Florida	......	......	......	......	......	38	62	......	......	......	......	89	77
Ohio	29	59	47	95	55	49	65	50	78	......	......	77	85
Indiana	60	48	45	60	64	65	62	76	77	80	77	71	81
Illinois	60	48	40	60	70	64	47	78	77	......	......	61	87
Michigan	49	78	56	50	50	68	68	71	78	75	72	82	85
Wisconsin	88	53	60	55	65	84	56	93	79	82	73	89	86
Minnesota	100	50	69	60	116	......	......	93	79	......	......	90	84
Iowa	69	26	52	60	87	70	40	86	79	......	......	70	89
Missouri	35	75	46	63	48	41	46	62	71	......	......	40	79
North Dakota	......	......	......	......	......	......	......	......	......	......	......	85	74
South Dakota	83	60	72	93	100	......	......	65	82	......	......	75	80
Nebraska	49	63	54	85	85	57	55	68	73	......	......	54	80
Kansas	29	71	47	110	60	34	53	45	68	......	......	40	73
Kentucky	51	70	49	65	56	45	54	78	74	......	......	64	87
Tennessee	42	80	51	75	55	32	51	72	68	......	......	69	84
Alabama	46	61	53	76	84	46	58	74	71	......	......	81	84
Mississippi	50	60	50	100	91	59	57	82	68	......	......	80	82
Louisiana	60	68	52	100	140	70	64	81	74	......	......	77	73
Texas	52	76	58	110	100	48	61	74	71	......	......	70	70
Oklahoma	43	73	60	100	78	38	53	63	65	......	......	41	63
Arkansas	58	73	52	80	76	48	48	78	68	......	......	73	76
Montana	77	90	86	100	80	80	81	......	......	......	......	92	77
Wyoming	90	100	80	......	......	......	......	......	......	......	......	102	80
Colorado	75	70	70	85	88	58	65	72	76	......	......	91	77
New Mexico	71	65	61	100	100	70	72	83	71	......	......	75	75
Arizona	75	85	70	190	204	81	81	90	82	......	......	93	88
Utah	82	91	77	85	75	75	72	90	89	......	......	93	89
Nevada	75	95	75	180	110	72	69	90	76	......	......	100	84
Idaho	77	94	80	85	80	79	77	95	87	......	......	87	83
Washington	69	89	78	87	65	78	82	88	88	......	......	85	79
Oregon	79	94	78	84	73	82	80	90	88	......	......	96	84
California	55	86	80	100	70	70	83	79	89	......	......	84	90
United States	46.6	67.8	54.1	76.5	62.2	58.1	66.5	73.3	83.3	71.5	74.1	77.0	81.7

[1] Production compared with a full crop

Vegetable crops: Estimates and forecasts based upon returns Oct. 1, with details by States.

State.	Potatoes.						Sweet potatoes.	
	Condition Oct. 1.		Production (000 omitted).		Price.		Condition Oct. 1.	
	1913	Average.	Forecast 1913	1912	1913	1912	1913	Average.
	P. ct.	*P. ct.*	*Bushels.*	*Bushels.*	*Cents.*	*Cents.*	*P. ct.*	*P. ct.*
Maine	95	88	26,700	23,166	53	45	....	....
New Hampshire	75	82	2,000	2,380	77	72	....	....
Vermont	84	80	3,200	3,640	69	51	....	....
Massachusetts	75	78	2,800	3,380	82	71	....	....
Rhode Island	78	80	600	565	80	85	....	....
Connecticut	70	78	2,200	2,461	90	61	....	....
New York	59	75	26,800	38,160	86	54	....	....
New Jersey	70	77	8,400	9,936	68	61	90	86
Pennsylvania	70	74	21,400	28,885	79	54	78	83
Delaware	77	77	1,000	1,100	85	60	91	85
Maryland	68	77	3,100	4,144	69	52	82	84
Virginia	80	81	8,200	8,265	65	71	83	85
West Virginia	67	80	3,500	5,264	91	69	81	81
North Carolina	80	81	2,300	2,550	78	70	87	85
South Carolina	75	80	700	900	134	122	81	84
Georgia	80	84	800	936	110	95	83	85
Florida	87	85	1,100	1,023	115	120	89	89
Ohio	57	75	12,100	20,832	103	58	73	81
Indiana	46	73	4,500	9,918	95	54	69	79
Illinois	43	73	6,600	13,837	101	64	59	81
Michigan	69	73	30,700	36,750	63	41	....	....
Wisconsin	79	74	30,200	34,920	54	35	....	....
Minnesota	83	78	24,700	33,075	49	31	....	....
Iowa	51	73	10,500	18,966	92	53	67	82
Missouri	40	72	3,900	7,960	102	68	46	78
North Dakota	78	79	4,600	6,656	53	32	....	....
South Dakota	76	82	4,600	6,510	67	43	....	....
Nebraska	48	74	5,600	9,440	82	58	....	....
Kansas	46	66	3,200	5,740	96	74	47	77
Kentucky	49	81	2,400	5,151	105	69	67	83
Tennessee	61	82	2,100	3,344	93	75	65	83
Alabama	78	83	1,100	1,215	106	95	79	84
Mississippi	76	80	800	890	104	98	81	82
Louisiana	77	78	1,400	1,460	90	86	85	86
Texas	60	70	2,800	3,276	107	111	68	71
Oklahoma	59	67	1,800	1,740	111	107	50	76
Arkansas	70	76	1,800	1,750	99	93	71	78
Montana	82	87	5,000	6,105	58	51	....	....
Wyoming	92	82	1,600	1,540	89	59	....	....
Colorado	74	76	9,400	8,075	63	60	....	....
New Mexico	45	78	400	900	125	104	....	....
Arizona	75	83	100	125	127	101	....	....
Utah	88	87	2,800	3,515	58	43	....	....
Nevada	96	94	1,700	2,136	58	75	....	....
Idaho	85	88	4,900	6,475	55	46	....	....
Washington	81	82	8,400	11,356	53	42	....	....
Oregon	91	85	7,200	10,075	58	38	....	....
California	77	88	7,200	10,140	80	71	86	93
United States	67.7	76.4	319,000	420,647	73.9	51.1	80.1	83.1

Vegetable crops: Estimates and forecasts based upon returns Oct. 1, with details by States—Continued.

State.	Cabbages.				Onions.				Beans.	
	Yield per acre.		Production.[1]		Yield per acre.		Production.[1]		Production.[1]	
	1913	1912	1913	Average.	1913	1912	1913	Average.	1913	Average.
	Tons.	*Tons.*	*P. ct.*	*P. ct.*	*Bush.*	*Bush.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Maine	6.8	8.0	80	86	328	210	80	86	83	84
New Hampshire	6.5	7.2	77	85	300	239	80	87	79	86
Vermont	4.8	5.7	80	90	270	300	78	85	75	86
Massachusetts	6.8	7.0	84	86	310	340	71	81	84	82
Rhode Island	6.8	8.5	78	84	250	300	77	79	85	81
Connecticut	6.7	7.5	85	87	190	260	73	83	78	85
New York	5.5	10.0	60	82	207	245	74	84	65	82
New Jersey	5.5	6.0	80	81	175	240	83	83	87	82
Pennsylvania	4.8	5.5	73	77	160	200	83	84	78	81
Delaware	5.0	4.5	82	74	160	200	90	85	......	......
Maryland	3.5	4.1	73	74	170	180	84	83	76	80
Virginia	2.7	2.5	75	78	110	100	88	86	77	80
West Virginia	4.0	4.5	79	82	175	160	89	87	82	81
North Carolina	2.7	3.0	78	78	95	100	87	87	84	81
South Carolina	2.8	3.0	82	80	110	125	87	85	85	78
Georgia	3.9	2.9	78	80	90	100	88	84	82	82
Florida	......	......	87	78	......	......	......	......	......	......
Ohio	4.5	5.2	68	83	180	275	75	85	75	80
Indiana	3.9	4.1	63	79	200	275	72	85	64	78
Illinois	2.9	4.0	60	80	115	160	66	86	57	80
Michigan	4.6	5.7	78	80	200	225	84	80	77	78
Wisconsin	9.0	9.2	84	82	205	210	81	84	86	84
Minnesota	6.8	10.5	83	82	180	210	88	84	90	82
Iowa	2.9	5.0	57	79	115	150	66	82	73	84
Missouri	1.2	2.5	34	71	60	105	54	80	30	75
North Dakota	2.0	2.4	90	72	150	150	90	74	90	74
South Dakota	2.5	7.0	70	79	140	150	80	83	80	82
Nebraska	2.0	3.0	45	75	90	130	60	78	75	79
Kansas	1.0	2.7	40	71	75	130	58	77	50	73
Kentucky	2.0	2.4	55	79	100	100	81	87	56	82
Tennessee	2.3	2.0	65	82	100	110	81	80	50	83
Alabama	2.4	2.5	80	82	110	100	83	86	70	80
Mississippi	4.1	3.0	80	77	90	90	85	85	70	79
Louisiana	3.6	3.5	80	76	150	140	88	82	74	81
Texas	4.0	3.0	77	67	98	120	78	77	67	70
Oklahoma	1.2	2.0	38	56	65	90	62	74	......	......
Arkansas	2.5	2.1	69	72	105	120	78	84	60	74
Montana	6.0	5.5	91	90	180	175	90	91	98	89
Wyoming	3.5	5.0	90	85	190	210	90	85	91	93
Colorado	4.0	6.5	88	87	200	225	80	89	85	87
New Mexico	3.5	4.0	80	79	130	145	83	82	69	79
Arizona	4.0	5.5	90	87	140	150	87	89	88	88
Utah	6.8	7.0	87	89	225	260	94	92	......	......
Nevada	5.7	7.0	94	89	140	200	95	91	......	......
Idaho	5.3	5.5	91	90	170	230	90	94	96	88
Washington	5.2	6.7	85	84	190	230	86	89	89	86
Oregon	4.2	5.8	91	89	215	220	92	91	95	89
California	5.5	7.0	85	91	215	150	86	91	80	88
United States	4.9	6.7	71.2	79.5	171	200	77.6	84.2	75.7	80.9

[1] Production compared with a full crop.

Miscellaneous crops—Estimates based upon returns Oct. 1, with details by States.

States and Territories.	Tobacco.		Sorghum.		Sugar beets.		Peanuts.		Broom corn.		Hops.				Cowpeas.	
	Condition Oct. 1.		Condition Oct. 1.		Condition Oct. 1.		Condition Oct. 1.		Production.[1]		Yield per acre.		Quality.		Condition Oct. 1.	
	1913.	Average.	1913.	Average.	1913.	Average.	1913.	Average.	1913.	Average.	1913.	Average.	1913.	Average.	1913.	Average.
	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	Lbs.	Lbs.	P. ct.	P. ct.	P. ct.	P. ct.
Maine	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
New Hampshire	90	95	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Vermont	79	92	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Massachusetts	84	91	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rhode Island	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Connecticut	85	94	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
New York	60	88	.....	.....	.....	.....	.....	.....	.....	.....	550	577	90	85	.....	.....
New Jersey	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	88	89
Pennsylvania	70	89	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	80	82
Delaware	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	88	85
Maryland	82	83	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	81	86
Virginia	88	83	84	83	.....	.....	86	79	.....	.....	.....	.....	.....	.....	85	80
West Virginia	75	84	84	86	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	84	81
North Carolina	84	78	87	84	.....	.....	84	81	.....	.....	.....	.....	.....	.....	80	77
South Carolina	84	80	83	80	.....	.....	82	82	.....	.....	.....	.....	.....	.....	74	74
Georgia	91	89	87	85	.....	.....	85	86	.....	.....	.....	.....	.....	.....	80	80
Florida	88	91	90	80	.....	.....	90	88	.....	.....	.....	.....	.....	.....	.....	.....
Ohio	67	84	81	86	83	87	.....	.....	.....	.....	.....	.....	.....	.....	81	88
Indiana	72	85	78	85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	73	83
Illinois	65	86	65	84	80	86	.....	.....	70	82	.....	.....	.....	.....	69	85
Michigan	.....	.....	.....	.....	8[illegible]	86	.....	.....	.....	.....	.....	.....	.....	.....	71	82
Wisconsin	90	85	91	87	[illegible]	87	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Minnesota	.....	.....	91	86	86	86	.....	.....	.....	.....	.....	.....	.....	.....	81	86
Iowa	.....	.....	79	85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	78	87
Missouri	52	85	48	84	.....	.....	.....	.....	46	80	.....	.....	.....	.....	48	82
North Dakota	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
South Dakota	.....	.....	75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Nebraska	.....	.....	55	87	77	88	.....	.....	55	84	.....	.....	.....	.....	.....	.....
Kansas	.....	.....	42	85	60	83	.....	.....	55	78	.....	.....	.....	.....	60	80
Kentucky	67	83	70	84	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	68	85
Tennessee	73	85	72	85	.....	.....	65	83	67	84	.....	.....	.....	.....	65	84
Alabama	85	84	81	82	.....	.....	82	85	.....	.....	.....	.....	.....	.....	73	80
Mississippi	.....	.....	81	79	.....	.....	83	82	.....	.....	.....	.....	.....	.....	73	77
Louisiana	83	85	84	87	.....	.....	81	86	.....	.....	.....	.....	.....	.....	69	81
Texas	75	81	73	80	.....	.....	73	77	56	70	.....	.....	.....	.....	68	73
Oklahoma	.....	.....	56	83	.....	.....	60	72	45	75	.....	.....	.....	.....	55	77
Arkansas	70	82	71	78	.....	.....	73	78	.....	.....	.....	.....	.....	.....	65	79
Montana	.....	.....	.....	.....	97	96	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wyoming	.....	.....	.....	.....	95	95	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Colorado	.....	.....	.....	.....	87	90	.....	.....	60	84	.....	.....	.....	.....	86	89
New Mexico	.....	.....	.....	.....	84	77	65	74	.....	.....	.....	.....	.....	.....	70	83
Arizona	.....	.....	90	88	90	86	95	89	.....	.....	.....	.....	.....	.....	95	89
Utah	.....	.....	85	90	92	97	.....	.....	.....	.....	.....	.....	.....	.....	98	86
Nevada	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Idaho	.....	.....	.....	.....	95	91	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Washington	.....	.....	.....	.....	95	91	.....	.....	.....	.....	1,615	1,393	94	93	90	89
Oregon	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,250	1,030	100	94	93	92
California	.....	.....	.....	.....	84	92	.....	.....	.....	.....	1,600	1,354	97	94	94	90
United States	76.6	83.1	70.2	83.1	86.2	89.7	83.6	83.0	50.3	80.4	1,150	1,071	96.4	92.5	.....	.....

LEON M. ESTABROOK,
Chief Bureau of Statistics.

WEATHER CONDITIONS DURING THE PAST MONTH WITH RELATION TO CROPS.

The severe heat wave that had continued during the greater part of the summer over the Middle West was terminated about the end of the first decade in September, since which time much unseasonably cool weather has prevailed. Following the close of the heated period general rains set in over the western portions of the corn and cotton belts, where drought had so persistently prevailed, and throughout the remainder of the month precipitation was of frequent occurrence in those districts as well as to the eastward.

For the month of September as a whole the average temperature over the great Central Valleys was not far from the normal, the extreme heat of the first decade largely overcoming the continued cold of the last two decades of the month, while in other districts the departures from the average were moderate. Rainfall was above normal over much of the country, especially in the districts where drought had previously prevailed, the amounts in portions of the central and west Gulf States and over the Plains region as far northward as Kansas and Colorado being in many cases far in excess of the average.

For the period October 1 to date the weather has been moderately warm over all the great agricultural districts and rain has been heavy in many portions of the cotton region. The general outlook is for seasonal weather in the near future, without marked extremes in temperature, but with normal rainfall, and there is no indication at the present time of general frosts in the South.

Unusually early frost in September caused considerable injury to staple crops in the interior portions of New York and New England, and killing frosts have been rather general over the northern portions of the corn belt, but no material damage occurred, due to the early maturity of that crop on account of high temperatures and lack of rain in the latter part of the growing season. The weather was mostly favorable for cutting and curing the corn crop and for the growth of fall pasturage, but dry weather had interfered with plowing and succeeding wet weather has delayed seeding, so that the wheat crop is generally being sown somewhat later than usual, but under favorable conditions as regards soil moisture.

In the Southern States heavy to excessive rains have doubtless caused considerable injury and loss to cotton in the fields, and the continued wet weather has materially interfered with cotton picking, especially in the States to westward of the Mississippi River, where dry weather is now much needed. The abundant rainfall has been beneficial to top-growth cotton, and if frost is sufficiently delayed a considerable addition to the crop may be expected from that source.

In the great fruit districts of the West the weather has been mostly favorable for maturing and picking, and the drying of raisins and other fruits has progressed satisfactorily.

C. F. Marvin,
Chief of Weather Bureau.

THE OUTLOOK FOR MEAT PRODUCTION.

This discussion of the outlook for meat production in the United States is offered in the belief that the present situation is far from being serious enough to occasion alarm, and that the country is well able to meet the present deficiencies, which are due largely to important changes in our system of cattle raising.

Coupled with the rapid settlement of the grazing ranges and the division of these natural pastures into cultivated farms, has been the increase in the value of corn, which acted as a deterrent to corn feeding of cattle for market on the small farm. At the same time, the wide spread in the South of the cattle tick, the occurrence of hog cholera, and other diseases which militated against meat production, have tended to lessen the supply of meat animals.

The articles which follow are designed to point out ways and means by which meat production in the settled sections may be increased. The writers of these articles have treated the subject not from a theoretical point of view, but have borne in mind constantly the fact that the farmer, before he will undertake the raising of more meat animals, must see in them a source of direct profit.

The writers realize that in many instances the farmer can not begin at once to raise meat cattle with profit, and that several preliminary readjustments of farm economy are necessary before the production of meat animals can be made a source of positive profit in the more settled sections.

THE MEAT SITUATION.

The high cost of meat is a serious reality, and it is now obvious that the rise in prices in recent years is the natural result of an actual shortage in production. This condition is reflected in the per capita consumption of meat in the United States, which is estimated to have fallen off 10 pounds in 4 years, or from 162 pounds in 1909 to 152 pounds in the fiscal year 1913. (These figures are exclusive of lard.) It is evident that the country is facing an era of short production of meat, and that some constructive means must be adopted if the American appetite for this class of food is to be supplied.

The decline in beef production is especially marked. This is shown in three different ways—by the number of cattle on hand, the number received at market centers, and the number slaughtered. A decrease in market receipts and in the slaughter with a corresponding increase in the number remaining in the country would not be alarming; but when with a diminishing slaughter we are depleting our stock of cattle there can be no doubt of the gravity of the situation.

In the last six years the number of beef cattle in the country has apparently fallen off over 30 per cent, while the population has of course increased. According to estimates of the Bureau of Statistics of the Department of Agriculture, the beef cattle in the country on January 1, 1907, numbered 51,566,000, and at the beginning of the present year the number was only 36,030,000. Meanwhile the number of dairy cows has remained practically stationary.

The receipts of cattle at six of the principal live-stock markets (Chicago, Kansas City, Omaha, St. Louis, St. Joseph, and Sioux City) for the first 9 months of 1913, as reported in market journals, were very slightly in excess of the receipts for the same period of 1912, but in comparison with 1911 there was a decrease of nearly 10 per cent.

The slaughter of beef under Government inspection, which covers more than half of the total slaughter of the country, shows a steady falling off since 1910, the total decline amounting to over 800,000 carcasses, equivalent to about 450 million pounds of dressed beef. Applying the ratio of Federally inspected slaughter to total slaughter according to the census figures for 1909, this means a falling off of 1,419,000 cattle, or approximately 780 million pounds of beef, in the entire slaughter of the country from 1910 to 1913. The following table shows the inspected slaughter in detail for the past four years. Sheep show a steady increase, as do hogs for a portion of the period, but the quantity of meat furnished by these smaller animals is of course relatively less than that from cattle.

Animals slaughtered under Federal inspection, fiscal years 1910 to 1913.

Year ended June 30—	Cattle.	Calves.	Swine.	Sheep.	Goats.
1910	7,962,189	2,295,099	27,656,021	11,149,937	115,811
1911	7,781,030	2,219,908	29,916,363	13,005,502	54,145
1912	7,532,005	2,242,929	34,966,378	14,208,724	63,983
1913	7,155,816	2,098,484	32,287,538	14,724,465	56,556

With our diminished production in the face of the heavy demand and high prices of the home market we no longer have a surplus for export, and it is no wonder that our export trade in meat animals and products has declined heavily. Our once great trade with England in cattle and fresh beef has vanished, and the only considerable items now shipped to foreign markets are prepared hog products, such as bacon, hams, and lard. From 1904 to 1906 our exports of live cattle approximated 600,000 head annually. For the last fiscal year (1913) they numbered only 24,714, about one-tenth of which went to Great Britain.

Up to the present year our meat imports have been so negligible that they were not separately listed in the commerce returns. Shipments of beef have recently been received from Australia on the one coast and from Argentina on the other. For years an unimportant number of cattle of the class known as "stockers" have come from Canada and Mexico.

While future imports may afford some measure of relief, too much reliance should not be placed upon this source of supply. A study of the statistical situation in other countries does not disclose where we are likely to obtain any large quantity of beef for an extended period. Besides our nearest neighbors, Canada and Mexico, the sources of imports are practically limited to South America (especially Argentina) and Australia. New Zealand exports large quantities of mutton but very little beef. Canada and Mexico do not at present give promise of substantial assistance. The number of beef cattle in Canada is only about one-ninth of that in the United States, and shows a steady decrease amounting to over 11 per cent in the last 5 years. Recently thousands of cattle have been brought in from Canada, mainly because of poor pasturage and partial failure of the hay crop there. This movement may continue for a time, but it will naturally have the effect of further reducing Canada's stock of cattle. The unsettled conditions in Mexico make it unlikely that any considerable number of cattle can be expected from that country for at least a few years. Argentina and Australia are already supplying most of the British imports, and have been called upon to make up the loss in the supply formerly furnished by the United States. The Australian colonies, however, are sheep rather than cattle countries and export probably four times as much mutton and lamb (by weight) as beef. Argentina is a large producer and exporter of beef, but has apparently reached the limit of its present cattle resources. The number of cattle in that country showed a decrease at the last census (1911) as compared with the preceding one (1908). The report from Buenos Aires that 7,262,000 cattle were killed in 1912 out of a total stock of 29,000,000 indicates that Argentina is drawing on its reserve.

It appears that England alone could probably take all of the foreign beef available for export, to say nothing of the new markets which have already been formed in other European countries. We shall therefore have to bid against England and other purchasers of foreign beef, and this competition will tend to keep up prices. It must be remembered, too, that this foreign beef is not up to the standard of quality of our corn-fed beef.

In view of the present meat situation at home and abroad, it is unlikely that our cattle raisers will have much to fear from foreign beef.

JAMES M. PICKENS,
Bureau of Animal Industry.

NEED FOR LOCAL MARKETS FOR LIVE STOCK.

Before the days of the packing house each locality produced its own meat. The packing house, with artificial refrigeration, made it possible to ship dressed meat long distances. Live stock produced on the range and finished on cheap corn supplied the packers with cheap meat, with which they soon captured the markets of the country. The local butchers stopped butchering and began to handle the packers' meats. This destroyed the local markets for live animals, and as a result the production of beef in the older farming sections was practically discontinued and the production of other meat animals was greatly reduced.

In recent years the high price of corn and the reduction in the area of the range has wrought a great change in the live-stock situation. At present the meat supply is decreasing and the consumption is increasing. This situation has forced upon us a problem which can be met in but one way, and that is more live stock must be produced upon farms.

Two things are necessary to induce the farmer to produce live stock: First, he must have a ready market for his animals, whether few or many; and, second, he must be able to realize a profit on their production.

MARKETS FOR LIVE STOCK.

Farmers will not produce to any extent a crop for which there is not a ready market. Except in the vicinity of some of the larger cities, the older farming sections have very poor markets for animals on the hoof. Often there is no market at all for animals in small lots, and this is the only kind of market that is worth much to the farmer. If beef is ever produced extensively on the farms, it probably will be as a side line and not as the main product. In this case cattle in large numbers will never be produced by one man, as in the West. Therefore, the central market which suits the rancher and feeder does not suit the farmer. He needs some kind of a local market.

Of course when meat production in a community becomes established, buyers will come in and pick up the small lots, put them together and ship them to the central markets. But at present in many farming communities which are producing practically no meat, there are some farmers who would, if they had a market, begin to produce some live stock, because they think they can do so without much additional labor or expense. But where is the beginner in such a community going to find a market? He alone can not find it; he must have the assistance of some of his neighbors. By cooperating, several farmers in a neighborhood can plan to raise the same kind of animals, have them ready for market at the same time, and ship in carload lots. This will make it possible for a few farmers in any community to secure a ready market at all seasons. However, until the spirit of cooperation becomes stronger among our farmers, this plan will not be regarded as furnishing very ready markets. In communities where a large quantity of live stock is produced, the farmers can, under fair competition, cooperate and slaughter it themselves for local consumption, if they wish to do so.

When the farms become the main source of our meat supply, as seems inevitable, much economy will be gained where each community produces its own meat supply. Under such circumstances local slaughtering of some sort on a scale sufficiently large to be done economically seems essential to the greatest economy. This would tend to steady the market as well as to increase the economy of production, slaughtering, and marketing. At present, however, the important consideration is a good market for animals in small numbers. It is useless to expect the farmers to become interested in live-stock production until there is a ready market.

ECONOMICAL PRODUCTION OF MEAT.

At present the most fundamental factor in profitable meat production is the cost of pasturage and feed. The ranges of the West are falling off in meat production because their areas are decreasing. The farming sections have more surplus feed than the ranges, but they have not the pastures. If this falling off in the range pasturage were replaced by pasturage of better quality on the farms, and if suitable markets for the farms were created, is it reasonable to conclude that the normal production of live stock would be restored? That will depend very largely upon the cost of the farm pastures.

FARM PASTURES.

Except on the level prairie lands, almost every farm contains some land that is too rough for cultivation. In the mountainous and semi-mountainous regions the percentage of such land is very high. There are also many farms that contain fields which are subject to frequent overflow. These rough lands and overflow lands, while often very rich, are usually not profitable for cultivation. There are many millions of acres of such lands in the United States, now lying idle or being cultivated at a loss, that could be made into excellent permanent pastures.

In many cases it will require considerable work to improve these pastures, but once it is done little will be required to keep them up. The small farmer can devote his spare time to this work, and by improving a few acres each year add materially to the permanent value of his place. Few farmers are improving these waste lands as pastures. Furthermore, little is known as to the best methods of improving them. There are many difficult problems involved, as, for example, how best to remove or destroy the brush, what is the best treatment of the soil for grass, the best mixtures of grass for certain conditions of soil and climate, the best systems of grazing, the best way to prevent the growth of weeds, etc. These and similar problems must be solved for each locality, and in but few places have they received much attention. A large amount of information is needed but little is available, since but few investigations in this line have been made.

As to the possibility of converting a very large per cent of these waste lands into permanent pastures, there is little doubt; but as to the cost of doing it little is known. However, it is reasonable to suppose that if the developing of these pastures were thoroughly understood the cost would not be prohibitive, particularly when the permanency of the pasture is considered. The establishment of these pastures seems to be a necessity in order to put the live-stock industry of this country on a sound basis. This is particularly true in the case of the meat-producing animals. Dairy cattle, which have a greater earning capacity, can be kept on much higher priced land and, under some conditions, without pasturage.

FEED.

A large percentage of the farms containing rough land suitable only for pastures are devoted to general farming and produce large quantities of feed. Often much of it is wasted; but with proper care such farms usually can have enough to winter a certain number of animals. It is upon this type of farm that live stock can be kept most economically, because with a good pasture on the waste land and a careful utilization of forage, such a farm can be made to carry some live stock without materially affecting the other activities of the place.

THE NEEDS OF THE SITUATION.

There are many minor factors that have an important bearing on the live-stock industry; such, for example, as the control and eradication of contagious diseases, the skill of the farmer in handling animals, the kind of animals used, the eradication of the cattle tick in the South, etc. But with all these factors properly adjusted, the meat problem can not be solved until improved pasturage and cheap feed make economical production of meat on the farms possible and until the farmers are supplied with good markets for live stock.

The making and maintaining of cheap pastures is a subject for extensive investigations. The subject of live-stock marketing also requires study; and since cooperation is the best solution, it is important to teach the farmer how to cooperate.

The efficiency of any methods that may be developed by investigations must stand the practical test with animals. Therefore such tests should begin at once. There are a few farmers in almost every locality who are willing to help make such tests with various kinds of live stock. They are willing to furnish the land and the animals and do the work if they are given some assistance by a skilled live-stock man. Such tests will have more educational value in solving the problems of profitable production and efficient marketing than anything else that can be done.

The farms of this country have almost unlimited possibilities for live-stock production. If the farmers can be shown how to produce live stock at a reasonable profit and how to get a ready market for it when it is produced, they will furnish all the meat that is needed.

B. H. Rawl,
Chief of Dairy Division, Bureau of Animal Industry.

FUTURE MEAT SUPPLY OF THE UNITED STATES.

The question naturally arises whether we have reached the era of permanent scarcity of meat which comes sooner or later to all densely populated countries, or whether, by adopting suitable measures, we can for a period increase supplies to meet the needs of our increasing population. Whether this can be done depends on the underlying causes of the present shortage and the possibility of remedying them.

It is clear that the farmer is not making exorbitant profits from live stock and its products. If such were the case he would produce more instead of less of them. Except on the ranges, beef cattle have always been produced at a very small average profit, frequently at a loss. Farmers have produced beef mainly because they have been taught that live stock in some form is necessary to the conservation of soil fertility. We are now beginning to learn that this is not necessarily true, so that farmers no longer feel compelled to keep unprofitable animals merely for the manure they produce. This, in part, accounts for the decrease in beef cattle, and this factor will increase rather than decrease in importance as time goes on.

METHODS OF DISTRIBUTION.

An important reason why farmers produce less meat than formerly is to be found in the system of distribution from producer to consumer that has grown up in this country. In most of the countries of Europe public abattoirs have been constructed to which farmers may consign their fat stock, the meat from which is then sold to the consumer without passing through the hands of an interminable line of middlemen each of whom takes his toll. In this country the farmer receives only a small fraction of the price paid by the consumer. Enormous packing establishments have monopolized the business, and there is little or no competition in buying the farmer's stock. The enormous fortunes that have grown up in this business in recent years show that the farmer has not been getting his full share of the profits.

Again, the retail meat business as at present conducted in cities renders enormous profits necessary. Numerous small groceries, each with its independent delivery system, clerks, fixtures, etc., each serve a few patrons scattered over considerable overlapping areas. Better organization of the retail business, whereby it shall be conducted in larger units, with well-systematized methods of delivery, are seriously needed. Such organization should greatly lessen the retail price of meats and at the same time permit the farmer to receive better prices. This would encourage greater production. Private organizations for the systematizing of the retailing of meats, without public supervision, will not meet the situation. Such organizations have already grown up in the retail milk business, but instead of cheapening the product to consumers, or increasing the price to producers, they have converted the saving thus effected into exorbitant profits. Public abattoirs, with public sale of the meats of animals slaughtered at them, have become a crying need in this country.

EFFECT OF HOG CHOLERA.

The only meat-producing animal that has been distinctly profitable to the farmer during the past decade is swine. But these have not increased in numbers, because of the danger from hog cholera. There is every reason to believe that the elimination of this disease would result in an immediate marked increase in the number of these animals. This would soon lower the price to the farmer sufficiently to check the increase, so that there is little chance that the deficiency in meat would be entirely met from this source. Besides, pork products would not serve the purpose of beef in our dietary. There is now a preventive serum for hog cholera, the use of which may result in an important increase in the supply of pork products.

FUTURE SUPPLY OF SHEEP.

Sheep are not generally profitable to the farmer. Their numbers are slowly decreasing nearly everywhere except on the ranges, and the latter are so fully stocked that not much increase is to be looked for in that direction. There is no probability of any considerable future increase in the number of these animals.

POULTRY.

Most of the poultry products of this country are produced on farms under conditions that render the cost of production nominal. Much of the food consists of waste grains, insects, etc., which cost nothing. Most of the labor required is done at times that would not otherwise be profitably employed, or by members of the household who would otherwise be earning nothing. The farm price of poultry products is largely fixed by this nominal cost of production. Under such conditions, it is only the exceptional individual who can make poultry profitable as a major enterprise. There is, therefore, no prospect of increase in products of this class in greater ratio than the increase in population.

DECREASE IN BEEF CATTLE.

While many causes have contributed to the amazing decrease in the numbers of beef cattle in this country in recent years, the decrease in the number of cattle on the ranges of the West and the recent marked increase in the price of corn without a corresponding increase in the value of beef cattle on the farm are the principal ones.

During the last census period corn increased in value at the farm 80 per cent, while steers increased in value only a small fraction of this amount. Steer feeding was not highly profitable even under the old conditions. Under the new conditions the business was conducted at a loss for several years. But cattle have been higher and corn lower in price since 1910, until the drought of this year. Even now, with corn selling at a dollar a bushel in some western beef-feeding sections, the price of cattle at the farm is little higher than before the effects of the drought were noticeable.

The ranges were long ago quite fully stocked. In recent years much of the best of the range has been converted to dry farming. The poorer ranges, suitable only for sheep, have not been so much occupied by farmers. Hence cattle have decreased while sheep were slowly increasing on the range. A flurry of high prices for range cattle a few years ago caused many cattlemen to dispose of a large proportion of young female stock, thus leading to later decrease in the size of their herds. Since a large proportion of the cattle fattened in the corn belt come from the ranges, there has been in recent years a notable shortage of feeders.

POSSIBILITIES OF INCREASE IN CATTLE.

There are several possibilities of increase in the number of beef cattle. In the first place, young cattle have increased greatly in price with the prevailing shortage of feeder stock. This tends to make profitable the growing of young stock of the beef breeds on farms that could not afford to do so formerly. Any considerable increase in the price of beef cattle at the farm would probably result in a few years in a marked increase in the rearing of calves on farms, if not on ranges. It would also tend to stop the slaughter at birth of male calves of the dairy breeds, as well as to decrease the number of calves of both sexes now made into veal.

There can not be a great increase in cattle on the ranges, for reasons already given.

The elimination of the cattle tick in the South, thus removing the danger from tick fever, will undoubtedly have an important bearing on the future supply of beef cattle in this country. The South, with her short, mild winters and her abundance of good grasses, can grow young cattle cheaper than the North, though she can not fatten them so cheaply as can the corn-belt States. With the tick eliminated, the South could thus produce millions of feeders which could be fattened in the North, to the profit of the southern farmer and the advantage of the northern corn grower and the consumer of beef as well. The eradication of the cattle tick thus rises to the dignity of an important national problem. Already more than one-fourth of the infested area has been cleared, and the work is progressing rapidly under the joint auspices of the Nation and the States concerned. But it has required seven years to remove ticks from one-fourth of the area. This work should be pushed more vigorously.

FOREIGN SUPPLIES.

The importation of beef from Argentina has already begun. What proportions this trade may assume and what effect it may have on domestic supplies and prices can not be fully foreseen. It seems probable that, with meat scarce and dear in Europe, it can hardly become plentiful and cheap in this country as the result of importations which are free to enter the markets of England. If importations should reduce the price of cattle on the farm the domestic supply will undoubtedly decrease, but this does not appear to be likely. The foreign supply seems hardly sufficient to supply both Europe and America with cheap beef, unless it be of very poor quality.

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Bureau of Plant Industry.

THE INFLUENCE OF THE AVERAGE FARM ON THE MEAT SUPPLY.

The question has been asked, "What is feasible to increase the output of meat on the average farm?"

The output of meat on the average farm can be increased (*a*) by the prevention of waste, (*b*) by the use of more economical methods, and (*c*) by the increase of production.

(*a*) The amount of waste in animal production reaches very large totals. For example, it is estimated that 15 per cent, or $45,000,000, of the annual value of our egg crop is lost on account of improper methods of handling. Of this amount, one-third, or $15,000,000, is due to "blood rings." Blood rings are dead embryos, and an embryo can only develop in a fertile egg. Hens which do not run with male birds do not lay fertile eggs, but they lay just as many eggs as if the males were with them. The presence of male birds, and that alone, causes all the blood rings in the eggs of commerce. Practically all of these eggs are produced on farms, and farmers can, therefore, add $15,000,000 to their income annually and to the national food supply by eliminating the fertile eggs from trade.

A much more important waste is the unnecessary loss of young animals. Take pigs, for example. When a sow farrows from 5 to 10 pigs, the owner does not grieve if three or four of them die. Probably 30 per cent of all pigs farrowed alive die shortly after birth from various causes. If the litter does not number more than 10, the sow can readily raise them all. Why, then, allow four or five pigs to die from lack of attention or suitable quarters? Most little pigs die because they become chilled at or soon after birth. Sows should therefore have dry quarters for farrowing, sheltered from winds, with plenty of bedding. This does not mean expensive quarters, but dry and protected ones. Such shelters can be built at very little expense.

Although the domestic animals of the United States are doubtless quite as healthy as those of any other country, the waste from disease and parasites is enormous. Attention has frequently been directed to the condemnation of carcasses and parts of carcasses in Federally inspected abattoirs. Large as is this direct loss in our meat supply, it is insignificant when compared with the actual losses on farms. Hog cholera, Texas fever, tuberculosis, infectious abortion, scabies and other parasites cause losses amounting to hundreds of millions of dollars annually, not only directly in the deaths of animals but indirectly in diminished vitality and feeding value of those which do not succumb. The eradication of these diseases and parasites is commanding the extensive use of public funds. Their prevention is a matter of sanitation, largely in the hands of the average farmer.

(*b*) The use of more economical and rational methods of breeding, raising and feeding live stock is imperative for the maintenance of the industry on high-priced lands. Grain can no longer be fed to meat animals with a lavish hand. Hay, fodder, silage and pasture are the cheapest feeds and will carry animals along with a minimum of grain. The use of straw and roots is coming. The farmer who keeps the frames of his young animals developing on these cheap feeds, withholding the full-grain ration until the finishing period arrives, will profit by such a practice.

The education of the farmer, to appreciate duly the importance of live stock in the maintenance of soil fertility, also deserves attention. The English and Scotch system, to feed for the manure, is sound. If farmers in those countries break even on their feeding, without calculating the value of the manure made, they rightly regard the feeding as profitable.

Finally, feeding will not be profitable unless laid upon a foundation of rational breeding, which resolves itself into the well-known slogan "Kill the scrub." The scrub is unprofitable. Consistent line breeding, using males of the same breed in succession, will give animals in a few generations of breeding up from native females, which are practically purebred, which are uniform in appearance and in feeding qualities and which are more salable on account of this uniformity.

(*c*) Our meat supply can be maintained or even increased in the following ways:

(1) By the revival of beef cattle raising in the corn belt and its extension in Eastern States. Up to the time of the rapid increase in the price of farm lands, farms in the corn belt where beef cattle were raised were common. The rise in value of land and the increase in the price of corn caused pastures to be plowed up and the beef cows disposed of. A reaction is now setting in which promises to become important. A similar movement is noticeable in the Eastern and New England States. Success depends on the utilization of pastures and cheap roughage.

(2) By the use of dual-purpose cows. In strictly dairy sections, especially those producing market milk, the dairy cow is the only one to be considered. Her calf is an incident—a necessary evil. The production and marketing of milk is the dairy farmer's business, and he can not afford to let his attention be diverted from the main matter in hand. On thousands of diversified farms, however, especially where cream is sold to "centralized creameries," only a few cows are kept, and they are only part of the farmer's business; the milk is but one of several sources of income. In such cases the cows should produce calves that will make profitable feeders.

(3) By raising sheep more extensively in the corn belt and in eastern States. The importance of the wool industry causes farmers to overlook the value of sheep for mutton and as weed destroyers. A small flock of sheep of one of the mutton breeds should be kept on every farm to graze the roadways, the stubble fields after grain is

cut, and the corn fields after the corn is full grown. Both wool and lambs are saleable.

One of the best opportunities for sheep feeding will be found in the irrigated West. Proximity to the range and the great value of alfalfa hay for fattening sheep make this business attractive.

(4) By increasing hog production on the irrigated farms of the West and by making pork production an adjunct of the creamery wherever conditions permit. The irrigation farmers have a splendid opportunity for the profitable production of pork of the highest quality. Pigs can be raised at a minimum cost on alfalfa, and should then be finished on grain, such as barley and peas. A brood sow can be wintered on alfalfa hay and a few sugar beets daily, without grain.

At creameries, where no use is made of skim milk or buttermilk, pig feeding should be an important side line. Corn and milk make an economical ration for fattening, and one which produces pork of excellent quality.

(5) By increasing the production of beef cattle and hogs in the South. The South is the only section of the United States where cattle can still be raised, fed, and sold at a profit at from 5 to 6 cents per pound. The tick has been almost the only drawback to cattle production in the South, but its passing is simply a question of time and industrious perseverance.

The hog is the beef steer's boon companion. He is increasing in numbers in the South, and southern farms will in time supply the pork eaten by southern farmers, and perhaps a good deal for the market as well. The wonderful development of the boys' corn clubs is now being supplemented by the organization of boys' pig clubs. The boys of the South have been shown how to grow corn; they are now being shown how to feed it to hogs.

(6) By increasing the poultry output of the farm. Poultry and poultry products have a profound influence on the meat supply, but less attention is probably paid by farmers to the breeding of farm poultry and their care than to any other animals. With easy possibilities for rapid improvement by the use of purebred males, our farm flocks still remain, as a class, decidedly underbred.

Almost every section of the country can produce chickens. Every farm could maintain a larger and a better flock. The South offers unusual opportunities for the production of poultry on the farm, on account of the early laying season, and the girls' poultry clubs now being organized as supplements to the canning clubs promise to become an important factor in the increase of the farm poultry industry, not only in the South, but in other sections of the United States as well.

GEORGE M. ROMMEL,
Chief of Animal Husbandry Division,
Bureau of Animal Industry.

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FARMERS' BULLETIN
561
Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.
December 8, 1913.

BEAN GROWING IN EASTERN WASHINGTON AND OREGON, AND NORTHERN IDAHO.

By Lee W. Fluharty,
Assistant Agriculturist, Office of Farm Management.

INTRODUCTION.

The arable land of eastern Washington, eastern Oregon, and northern Idaho has been devoted almost exclusively to the production of wheat, oats, and barley for more than 30 years. Because of the introduction of serious weed pests soon after the land was brought into cultivation it was found unprofitable to grow a crop of grain each year. Many of the new settlers had come from the Willamette Valley, Oreg., where wheat and oats were grown by summer-fallowing the land every second or third year. Hence, they naturally turned to this system of farming as a solution of their weed problem, and the growing of small grain by the summer-fallow method is still the general practice among the farmers of this region. Under this system of farming from one-third to one-half of the land lies idle each season.

While wheat, oats, and barley are the crops most universally grown, a small portion of the wheat belt of Washington, Oregon, and Idaho is well adapted to the production of beans. The area best suited to this crop lies along the foothills of the Blue Mountains in Umatilla County, Oreg., Walla Walla, Columbia, Garfield, and Asotin Counties, Wash., and along the foothills of the Craig Mountains and adjacent to the canyons of the Clearwater and Potlatch Rivers in Nez Perce, Lewis, and Latah Counties, Idaho. A few districts are in Whitman, Spokane, and Stevens Counties, Wash., where the climatic conditions are favorable for bean culture. While it is true that only a limited area is adapted to this crop, a careful study of all the details of its production shows that thousands of acres now lying idle each year as summer fallow may be used for growing beans as an intertilled crop. This crop has been grown in parts of Nez Perce and Latah Counties, Idaho, for the past 15 years, and the bean hullers make their regular fall runs the same as the grain thrashers. The crop has also been grown in a more limited way near Weston, Oreg., for 15 years. The production of field beans in this territory is therefore past the experimental stage. A few days spent in the vicinity of Kendrick, Idaho, visiting bean growers during the months of July and August will convince the skeptical of this fact.

LIMITING FACTORS OF BEAN PRODUCTION.

Two factors largely determine whether beans may be grown successfully: (1) The annual precipitation must be sufficient to produce a crop each year and (2) the growing season from May 10 to September 15 must be approximately free from frosts. Owing to their proximity to the mountains the districts previously mentioned receive sufficient precipitation for growing beans when proper cultural methods are employed.

The deep ravines leading down from the mountains in these regions give protection from frosts during the growing season by furnishing excellent air drainage. While the danger from frosts increases with the elevation, air drainage is the principal regulating factor. In parts of Nez Perce County, Idaho, where the deep canyons furnish good air drainage, beans are being grown successfully at an elevation of 3,000 feet. In other parts of the same county having a lower elevation but poor air drainage, this crop can not be grown on account of the late spring and early autumn frosts.

The success of the bean crop also depends upon the quantity of moisture stored in the soil at the time of planting and upon the cultural methods employed in growing and harvesting the crop. It is the purpose of this bulletin, therefore, (1) to encourage bean culture in those localities that have a frost-free season of sufficient length to insure maturity and have enough rainfall to grow beans on land that usually lies idle as summer fallow and (2) to discuss in detail the cultural methods which have been worked out during the past 15 years by the most successful farmers in the bean-growing districts.

CULTURAL METHODS USED IN BEAN PRODUCTION.

Experience has demonstrated that the success of the bean crop depends largely upon the thorough preparation of the seed bed. While it is not the general practice, the work of preparation should begin in the early autumn. The most successful growers work the grain stubble into the soil with a sharp disk harrow soon after the coming of the first fall rains. When the ground is plowed after such treatment the stubble is evenly distributed throughout the soil, where it quickly decays and prevents packing. It is not always possible to disk the stubble in the fall on account of the rush of work at that season. If, however, the plowing is delayed until the following spring, fall disking is very necessary.

METHOD OF FALL PLOWING AND LATER CULTIVATION.

The ground is usually plowed to a depth of 6 or 8 inches in the fall soon after the soil becomes damp enough to be worked, or in the early winter. It is then allowed to lie until early spring in the rough state as left by the plow. The winter's precipitation is absorbed by the soil instead of being lost by running off. Much of the rainfall frequently is lost in this way when the land lies as a stubble field during the winter. When dry enough in the spring the soil is stirred with a disk or other suitable implement once or twice and then harrowed. A dry earth mulch is maintained until planting time for the purpose of retaining soil moisture and destroying weeds. This generally requires from three to four cultivations at intervals of 8 or 10 days. The use of the packer is not usually necessary after fall plowing, as the winter rains and numerous spring cultivations firm the soil sufficiently.

SPRING PLOWING.

Although plowing in the fall or early winter is preferable, it is sometimes done in the spring as soon as the ground is in condition to be worked. When the plowing is postponed until this season of the year the land has usually been disked the previous fall. Fall disking works the stubble into the soil and puts the ground in condition to catch and retain the winter's moisture. Cultivation is begun immediately after plowing for the purpose of checking evaporation and the germination of weed seed. The harrow must follow not more than one-half day behind the plow. Some farmers attach a section of a harrow to the gang plow and perform the two operations at the same time. A subsurface packer is sometimes used for the purpose of firming the soil and reestablishing capillarity. If used, the packer is run immediately behind the plow, and it in turn is followed closely by a drag harrow. The land is then handled until seeding time in the same manner as the fall-plowed ground. Plowing must never be neglected until late spring, for that permits the soil to become so dry that it breaks up in hard clods and much extra labor is necessary in preparing a suitable seed bed.

PLANTING THE BEAN CROP.

Time to plant.—The time of planting varies from May 10 to June 5, according as the season is early or late. When planted too early, cold weather, together with an excessive quantity of moisture in the soil, often causes the seed to decay before germination begins. Even if a good stand is secured under such unfavorable conditions the crop usually develops and ripens very unevenly.

Method of planting.—The double-row bean and corn planter is used almost exclusively for planting the crop. An excellent type of planter is shown in figure 1. This planter may be adjusted to plant in rows from 28 to 44 inches apart. By using a special 30-inch wire it will also plant the hills in 30-inch cross checks. The feed plates may be made to drop the desired number of seeds in each hill by regulating their speed. The planter is also equipped with an automatic hill-drop attachment which drops the hills from 17 to 52 inches apart in the row. If the ground is so foul as to require extensive cultivation the beans should be planted in checks with the hills 30 to 36 inches apart to permit cultivation in both directions. The field shown in figure 2 yielded 800 pounds of dry beans per acre.

It is considered very essential that the number of plants grown on a certain area be sufficient to maintain a proper balance between the soil moisture and the moisture requirements of the plants. If this balance is properly maintained the beans ripen evenly and a uniform crop is produced. In the sections where beans are being grown at present, from 6 to 8 seeds in each hill produce the proper number of plants. If a smaller number of seeds is planted in each hill there is often moisture enough in the ground to keep the vines growing late in the fall, and the late beans are sometimes damaged by early fall frosts. This problem must be worked out, however, for each locality having different soil and moisture conditions.

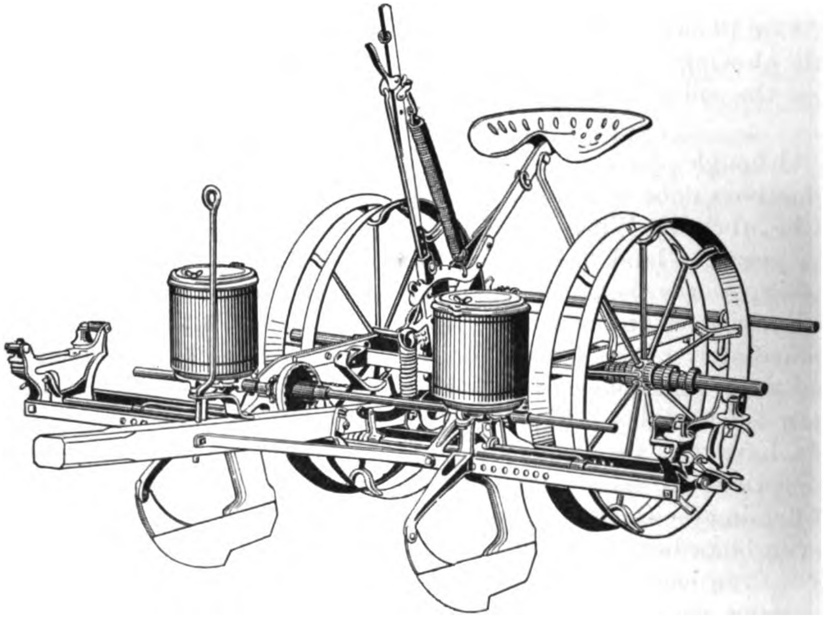

FIG. 1.—A double-row bean or corn planter.

A hand corn planter is often used for planting where only a small acreage is to be grown. The ground is marked off in checks about 30 inches square and the beans dropped at the intersection of the marks. An experienced man can plant from 4 to 7 acres a day by this method. If the ground is free from weeds, so that but little cultivation is necessary, the seed is often planted in drill rows with either a bean planter or an ordinary grain drill. Of the two, a bean planter which has a drill attachment is the more desirable.

A grain drill having feed cups which will handle beans may be used with fair success. An 11-row grain drill with a space of 7 inches between each drill tube can be adjusted for drilling beans in rows 28 inches apart by stopping up all of the feed cups except the second, sixth, and tenth. The machine is so regulated as to plant the seed from 3 to 6 inches apart in the row.

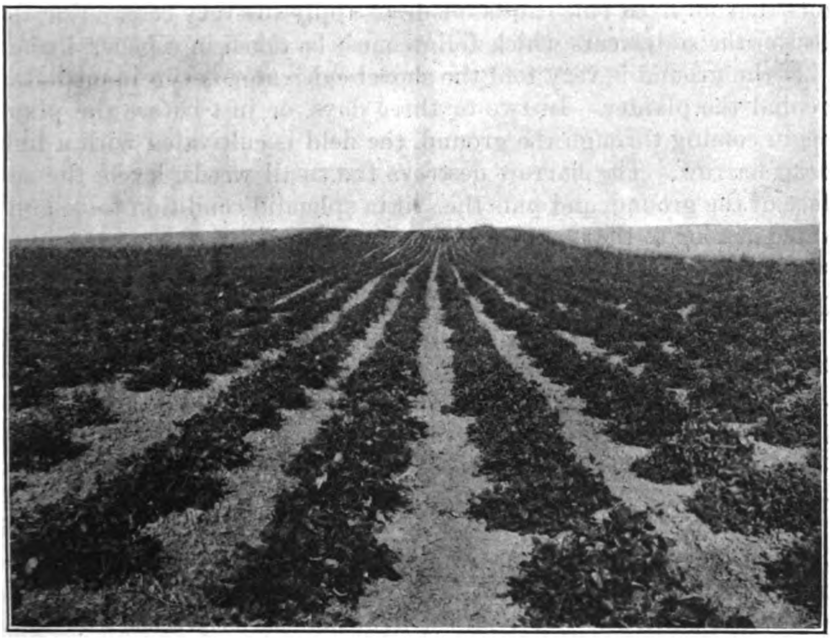

FIG. 2.—A field of beans planted in checks 3½ feet square in order to permit cross cultivation.

The depth at which the beans are planted depends upon the character of the soil and the weather conditions. They are not planted so deep in dark, heavy soil as in a lighter soil. Neither can beans be planted to a very great depth during cold, damp weather without injuring the stand. The safe plan is to plant just deep enough for the seed to lie in moist earth, for an even stand of strong, healthy plants is one of the first requirements of a good bean crop.

QUANTITY OF SEED PER ACRE.

The quantity of seed required per acre depends upon the size of the beans and also upon the manner of seeding. The pea-bean varieties, such as the Little Navy, the Lady Washington, and the Red Miner, require from 16 to 20 pounds per acre when planted in checks 30 to 36 inches square. If planted in drills or checked closer than this a larger quantity of seed will be necessary. The larger seeded varieties require more seed per acre than the smaller varieties.

CULTIVATION OF THE BEAN CROP.

The thorough preparation of the seed bed, as already indicated, leaves the soil in excellent tilth, destroys most of the weeds, and hence materially lessens the cultivations necessary after the beans are planted. The number of cultivations depends upon so many factors that no fixed rule can be made to apply to every case. For this reason the statements which follow must be taken in a general sense.

If the ground is very foul the shovel cultivator is run immediately behind the planter. In two or three days, or just before the plants begin coming through the ground, the field is cultivated with a light drag harrow. The harrow destroys the small weeds, levels the surface of the ground, and puts the soil in splendid condition to be cultivated as soon as the plants are large enough. If weed seed germinate at the same time as the beans, the ground is harrowed again after the plants are up.

Some growers object to harrowing, as they are afraid of injuring the stand by breaking off the young plants. Very little damage is done, however, if the seed bed has been so well prepared that the ground is level and free from clods and if a light harrow is used. Several growers near Weston, Oreg., have followed this practice for a number of years with satisfactory results.

One harrowing, either before or after the plants are up, is sufficient if the ground is comparatively free from weeds. It should be done when the weeds are most easily destroyed. Two or three additional cultivations during the growing season are usually necessary. The soil is not stirred to a depth of more than 2 or 3 inches, for the reason that the bean is a surface feeder and deep cultivation is liable to disturb the rootlets and thus weaken the plant by diminishing the food supply.

The implements employed in cultivating corn are the ones usually used in bean culture. Sweeps are substituted for the shovels, as they are better adapted to shallow cultivation. Level cultivation is practiced at all times. Cultivation is discontinued when the vines begin blooming, for at that time the flowers are easily knocked off. The late stirring of the soil keeps the plants growing and they are liable to be injured by early fall frosts.

HARVESTING THE BEAN CROP.

In the bean-growing districts of Nez Perce and Latah counties, Idaho, the bean harvest usually begins about September 10. The date varies, however, from August 25 to September 20, according to the season, the altitude, and the varieties grown.

A double-row bean cutter similar to the one shown in figure 3 is generally used for cutting the crop. One man with two horses can cut from 12 to 14 acres per day with a machine of this kind, the acreage varying with the width between the rows. Two men with pitchforks follow immediately behind the cutter and place three of the windrows in one row of piles.

Farmers who do not have an acreage large enough to justify them in purchasing a bean harvester sometimes make a cultivator serve the purpose. (Fig. 4.) All of the shovels are removed and a long knife is attached to each of the inside shanks. The sweeps are made to stand inward and backward at an angle of about 60° and are left long enough to overlap each other at the center of the cultivator. The beams of the cultivator are then tied together with wire in order to prevent spreading.

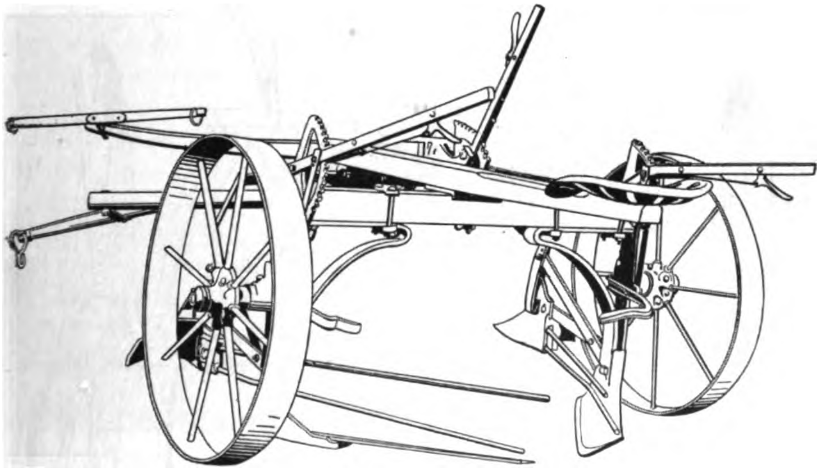

FIG. 3.—The double-row bean cutter generally used for harvesting the crop.

The plants are left piled in the field until the vines are thoroughly dry. It seldom takes more than two or three days for them to become dry enough to be hauled to the bean huller or stacked in the field or in sheds. Stacking in the field before thrashing is growing in favor, since in this way a larger acreage may be handled without danger of damage from rain. It is during the time the beans are lying in piles between cutting and thrashing that there is danger of damage from rain. If stacked, such damage is not liable to occur, as the stacking can begin within a couple of days after cutting and the beans are left in piles only a short time. Another advantage of stacking is that the vines go into a sweat soon after they are stacked and do not become thoroughly dry for three or four weeks after the sweating process begins. While in the sweat the vines, pods, and seed become toughened and there is less danger of cracking than if thrashed directly from the field.

Stacking.—The stacks are built on a layer of straw 12 or 14 inches thick in order to keep the pods from coming into contact with the ground. The straw also catches the seeds which are trampled out during the stacking process. The beans are separated from the straw by running both through the huller. The stacks are kept dry by covering them with heavy canvas. An excellent way to protect the beans until thrashed is to cover them with straw. On the top of the stack the covering should be 12 to 15 inches deep. The straw is held in place by a network of wires or binder twine.

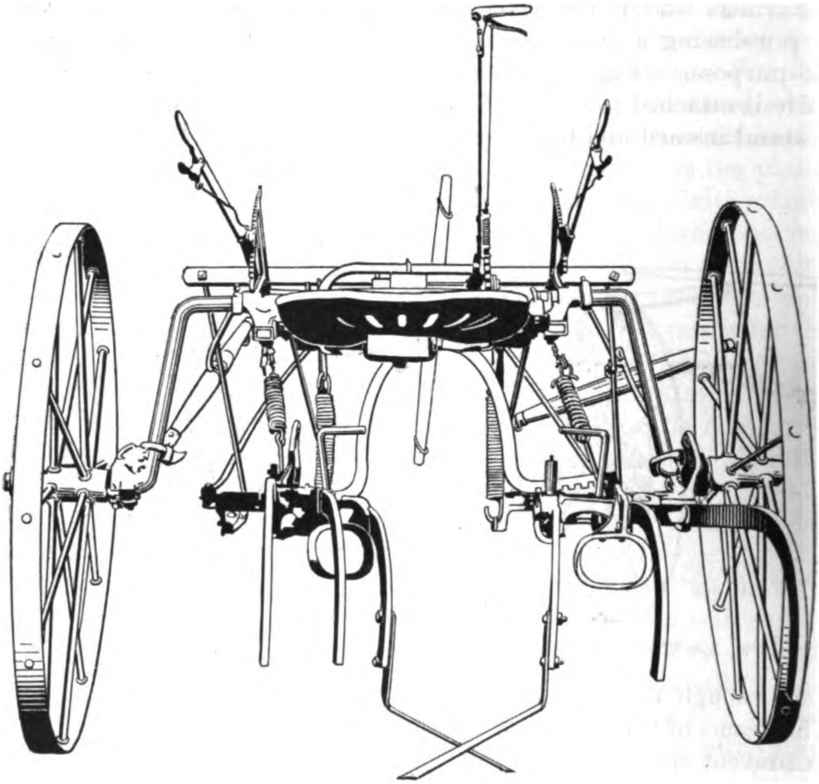

FIG. 4.—A cultivator made into a single-row bean cutter.

When handled properly beans are no more liable to damage from rain than grain crops. If a rain should come before the beans can be stacked they are turned as soon as the ground dries, as shown in figure 5. The pods must lie but a short time on the wet earth, as the seeds absorb moisture readily and are liable to become discolored. Care must also be exercised in handling the vines after they become thoroughly dry, for the pods crack open easily and much loss may result from shattering.

THRASHING THE CROP.

The thrashing is usually done with a bean huller, a machine designed to minimize the loss from cracking. Good work may be done with a grain separator, provided the vines have remained in the stack long enough to be in the sweat and the speed of the cylinder is slowed down to 300 or 400 revolutions per minute, the speed depending on the diameter of the cylinder. All but one row of the concave teeth and half of the cylinder teeth are removed, the separating parts of the machine are run at the same rate as when thrashing grain, and none of the thrashed beans are allowed to pass from the elevator into the cylinder a second time.

In districts where beans are a staple crop the bean hullers make a regular fall run, the same as grain thrashers. The charge for thrashing is usually 25 cents per sack, full sacks weighing from 140 to 150 pounds. This makes the charge about 16⅔ cents per hundredweight. The charge includes all labor connected with thrashing except hauling the vines from the field to the machine in case they are not stacked. Growers who have only a small acreage or who live in a community where there are no hullers do their thrashing with a grain separator or by means of a flail. Two men can flail out and clean up about 1,800 pounds per day.

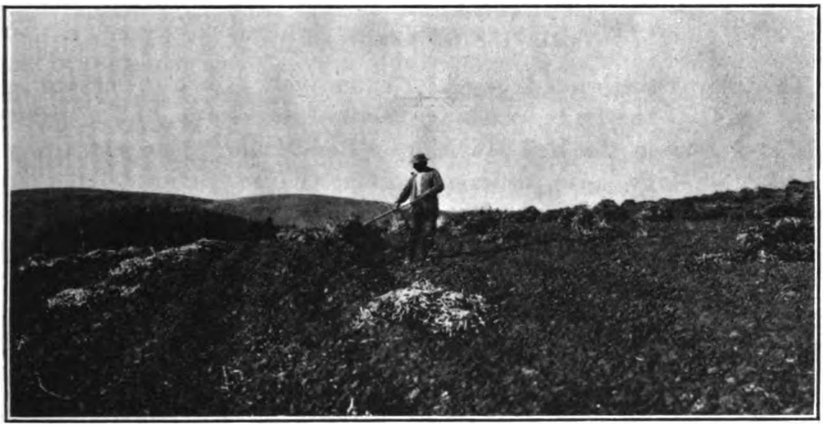

FIG. 5.—Turning beans after a rain. Note the condition of the soil as left by the bean harvester. It is ready for seeding to fall wheat.

MARKETING THE BEAN CROP.

Cleaning and grading in order to get a uniform and attractive product are very important items in the marketing of dry beans. As far as the farmer is concerned, this preparation usually ends with the thrashing operation. Many of the grain warehouses in the bean-growing districts are equipped with special machinery for this work.

After being scoured, recleaned, and graded into large, medium, and small sizes they are placed on the market in small sacks weighing 85 pounds each. The price to the grower usually ranges from $3 to $4.50 per hundredweight, according to the size and quality of the product. The smaller beans are most in demand and sell at a price from 50 to 75 cents per hundredweight higher than the larger beans.

It is sometimes necessary to hand-pick the crop on account of discolored beans if the harvest season is damp. The weather conditions are usually such, however, that hand picking is not necessary if the crop is handled properly. The operation of hand picking is greatly facilitated by small machines operated by foot or other motive power. These machines consist of a canvas belt 7 or 8 inches wide passing over rollers driven at a low speed. The beans are fed to the belt from a hopper and as they are carried along the pickers remove the discolored seed and foreign particles. The sound beans pass to the end of the canvas and drop into a sack or other receptacle.

VARIETIES OF BEANS GROWN.

The three varieties of beans most extensively grown in the regions mentioned are the Lady Washington, the Little Navy, and a variety locally known as the Red Mexican or Red Miner. Many strains of the Little Navy have different minor characteristics. They are grown under such names as Banner Leafless, Prolific Tree, and Prize Winner. The Red Mexican or Red Miner is the earliest of the three varieties and is preferred for late plantings or high altitudes where the season is short. All three of the most popular varieties are somewhat spreading and branching in character; they are very vigorous growers and extremely hardy. The Little Navy is especially prized for its hardiness, productiveness, evenness in maturing, and its uniformly well-filled pods.

IMPROVEMENT OF THE SEED BY SELECTION.

By carefully studying a field of maturing beans one will observe a wide variation in the individual plants. It will be seen that some of the plants are mature, while others are still green; that some are heavily laden with well-filled pods, while others bear only a small number of seeds. On account of this variation it is possible to greatly improve the crop by careful seed selection. The object of such selection is to increase the yield and vitality of the seed, to improve its quality, and to produce plants that will ripen evenly. In certain localities it is also desirable to select early-maturing plants in order to shorten the time required for maturing the seed. It is impossible, however, to obtain permanent results unless such selection is practiced every year, for bean plants have a strong tendency, if selection ceases, to return to the original type.

A practical method of seed improvement used by the most successful plant growers is as follows: In starting the work a large number of plants heavily laden with ripe pods are selected from the field at the time of maturity. The plants are taken from parts of the field where the stand is uniform and from soil which is representative of the general soil conditions. Plants from the outside rows or where the stand is poor are not representative and must not be used in seed selection.

The plants are pulled by hand, removed from the field, and carefully inspected to secure the 25, 50, or 100 which are best. These are thrashed individually and the beans from each plant put in separate paper bags, which should be numbered.

The following year these selected seeds are planted by hand, a separate row to each paper bag. Toward harvest time this will be the most interesting plat on the farm, since the grower will soon see that when selecting his best plants the preceding fall in many cases he did not "know beans." Quite a number of rows in this plat will be found to have produced progeny which are distinctly inferior in some respect. Here the advantage of these "progeny rows" will be apparent, since the grower is able to discard the bad rows entirely, whereas if he had not planted the seed from each selected plant to itself it would be practically impossible to remove the poorer types by roguing. One or a few rows will be found to be markedly better than the rest, and all of these good rows should be saved for next year's seed plat. The remainder of the seed plat, after discarding a few rows which may be distinctly bad, can be used to plant the field.

By one year's individual selection a strain can be established which may be kept fairly pure by discarding all the inferior plants from the seed plat. The plat should be sown each year and should be large enough to furnish all the planting seed desired. The extra labor in thrashing which this selection plan requires will come at a time of year when it can be spared, since the selected plants may be stored unthrashed for a while. The labor of hand planting will be richly repaid by the greater producing value of a selected strain of beans.

BY-PRODUCTS OF THE BEAN-GROWING INDUSTRY.

The value of bean straw as a rough feed is not fully appreciated by most growers. While a few farmers are feeding their straw, most of it is burned immediately after thrashing. Others allow it to partly decay in large piles and then use it as filling for ditches or as a fertilizer. When not allowed to become damp or moldy, bean straw makes a splendid roughage for either sheep or cattle, and when fed in conjunction with grain it is a very good substitute for hay.

Bean straw is superior in feeding value to wheat hay and but little inferior to barley hay. Beans will ordinarily yield from one-half to three-fourths of a ton of straw per acre. Taking as a basis the price usually paid for wheat hay in the bean-growing section, bean straw should be worth from $5 to $8 per ton when fed on the farm and the manure returned to the soil.

While there is but little waste caused from decay or discoloration of the seed during harvest, sometimes there is a quantity of cull beans due to the splitting or cracking of the seed during thrashing. These culls make very good hog feed when thoroughly cooked and fed in conjunction with other grain.

CONCLUSIONS.

Thousands of acres of land are lying idle as summer fallow each year in eastern Washington, eastern Oregon, and northern Idaho that are well adapted to the growing of beans. Fifteen years' experience shows that as good cereal crops can be grown following beans as after an ordinary summer fallow. The cultivation of the bean crop replaces the work necessary to care for the fallow, and leaves the soil in excellent condition for seeding winter wheat. The crop is also harvested in ample time to permit early fall seeding.

Beans do not seriously compete with wheat for labor, and the two crops can be grown with practically the same equipment. Approximately $150 worth of extra machinery is needed to plant, harvest, and cultivate from 70 to 80 acres of beans instead of cultivating the land as summer fallow. With the present wage for man and horse labor it requires about $6 more per acre to grow, harvest, and market a crop of beans than it does to summer-fallow an equal area. Since beans yield on the average about 800 pounds per acre and sell for 3 cents per pound, the gross return per acre is approximately $24. In districts adapted to bean culture, beans are therefore approximately $18 per acre more profitable than summer fallow.

Generally speaking, the soils of the bean-growing districts are rich in all of the mineral elements necessary for plant growth. Under such conditions the maintenance of soil fertility will depend almost entirely on keeping up the organic matter of the soil. This is not easily accomplished when beans and cereal crops are grown exclusively. Stubble should always be plowed under instead of being burned. The plowing under of partially decayed bean and wheat straw will also do much toward keeping the soil in a productive condition. The decayed straw should be scattered rather thinly over the grain stubble in the fall. It should be thoroughly worked into the surface soil with a sharp disk harrow and plowed under as soon as possible after the first autumn rains. The disking causes the straw to mix thoroughly with the soil at the time of plowing instead of forming a layer in the bottom of the furrow.

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December 18, 1913.

THE ORGANIZATION OF BOYS' AND GIRLS' POULTRY CLUBS.

By HARRY M. LAMON,
Senior Animal Husbandman in Poultry Investigations, Animal Husbandry Division.

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INTRODUCTION.

Statistics show that the loss due to the improper handling of eggs throughout the country is enormous, extending into many millions of dollars annually. It is an equally established fact that strictly fresh eggs command a higher price than those commonly designated as store eggs, and if the farmer, who is the largest producer of this well-known perishable commodity, would take more care in selecting, grading, and marketing this product he would receive a price higher than the average market one for his eggs. On many farms throughout the country the money derived from the sale of poultry and eggs buys the groceries and clothing for the entire family. The money from this source may be substantially increased by establishing a private trade in eggs of good quality with hotels, restaurants, etc., in towns and cities.

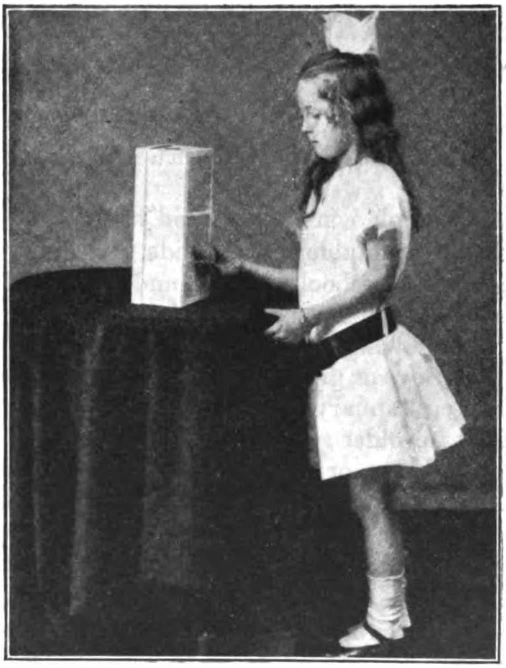

FIG. 1.—Testing eggs.

The object of forming boys' and girls' poultry clubs is to give a better knowledge of the value and importance of the poultry industry and the marketing of a first-class, uniform product, to teach better methods of caring for the poultry and eggs, and to show the increased revenue to be derived from well-bred poultry where proper methods of management are pursued.

ORGANIZATION.

Throughout the year meetings should be held to discuss the different problems of poultry management, and at such meetings the Animal Husbandry Division of the Bureau of Animal Industry, United States Department of Agriculture, will have in attendance. whenever possible, one of its specialists on poultry to assist in solving such questions or problems as might arise and to give whatever help and information he can to the members on such subjects as selection of stock, candling demonstrations, etc. He will also assist in securing first-class markets for the sale of the poultry and eggs.

Each county club should hold an exhibition once a year, preferably in connection with the county fair, at which place a pair of the best chickens grown by each member should be placed on exhibition and entered to compete in the regular classes for premiums offered by the fair association, as well as for the special prizes offered for members of the poultry clubs. An exhibit of the best dozen of eggs should also be made.

It will be well to have a president, one or more vice presidents, and a secretary.

It is advisable for the teacher in charge to be honorary president of the club.

A simple constitution and by-laws should be adopted. It will be found profitable to subdivide the county organization by townships, schools, or school districts, and have local meetings at schoolhouses or at different members' homes occasionally. Each club should adopt the following general regulations:

1. Boys or girls joining the club must be between 10 and 18 years of age on January 1 of any given year. Special classes may be organized for older girls.
2. No boy or girl shall be eligible to receive a prize unless he or she becomes a member of the club, and sets at least one sitting of 13 eggs.
3. Each member of the club must agree to study the instructions of the United States Department of Agriculture.
4. Each boy or girl must plan to do his or her own work and keep strict account of all expenses, such as feed, labor (for which 10 cents an hour should be charged), sale of stock, etc.

SUGGESTED CONSTITUTION AND BY-LAWS.

ARTICLE I. This club shall be known as the (insert name of the school district) Boys and Girls' Poultry Club.

ART. II. The objects of the club shall be: (1) To obtain a greater knowledge of the value of raising and breeding standard-bred poultry, (2) to teach better methods of marketing first-class poultry and eggs of uniform quality, and (3) to learn how to carry on the hatching, rearing, feeding, and housing of poultry.

Art. III. Any boy or girl between 10 and 18 years of age can become a member of the club on signing the membership roll and on agreeing to set at least one sitting of 13 eggs during the hatching season.

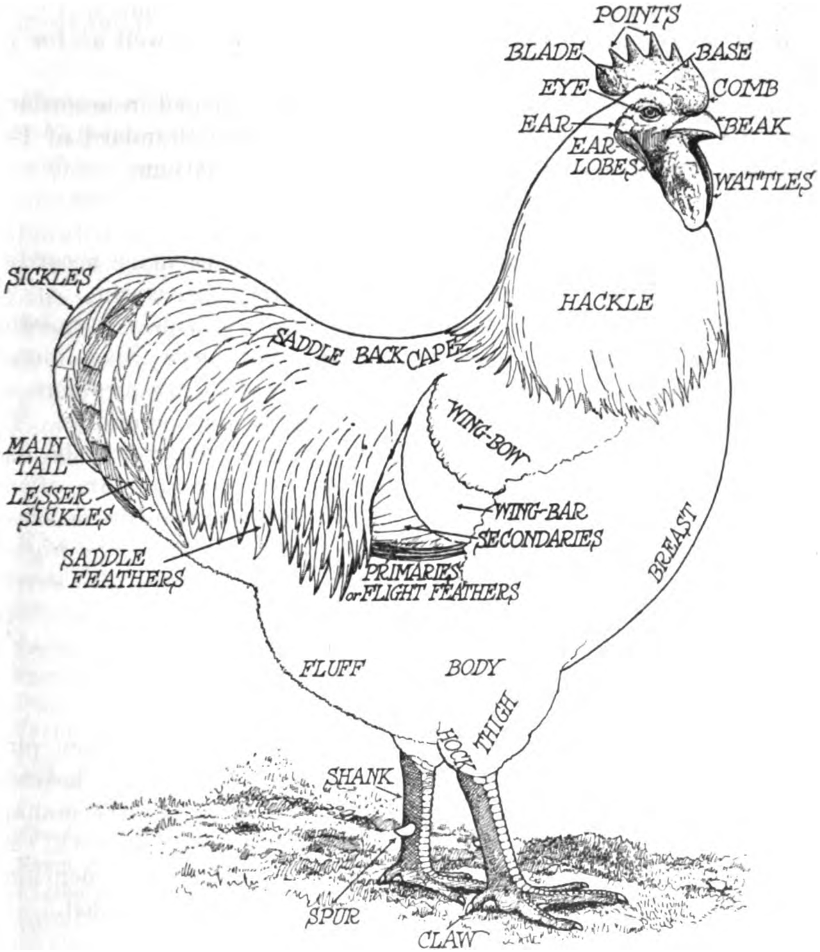

Fig. 2.—Glossary chart giving the names of the various sections of a male fowl.

Note.—In the female the cushion takes the place of the saddle of the male and the sickle feathers are absent.

Art. IV. Members shall not pay any dues or assessments.

Art. V. Each member must study the instructions sent out by the United States Department of Agriculture and agree to furnish reports of work when requested to do so.

Art. VI. The officers of the club shall be a president, a vice president, and a secretary.

ART. VII. The president or secretary has the right to call a meeting of the club at any time. The annual meeting shall take place as soon after January 1 of each year as possible. The officers for the ensuing year shall be elected at that meeting and shall hold office until their successors are elected.

ART. VIII. Each member is expected to exhibit every fall or winter live poultry of his or her own raising and one dozen best table eggs at a county fair or other suitable place. They can compete for the regular premiums offered by the fair association, as well as for the special prizes offered to the members of the club.

ART. IX. All prizes on live poultry must be decided in accordance with the standards of the breeds in the American Standard of Perfection, published by the American Poultry Association.

PRIZES AND AWARDS.

The award of prizes on fowls and eggs shall be made according to the rules published by the American Poultry Association.

It will be found best to distribute the prizes as widely as possible. Honor and recognition sometimes count for more than money. Badges, certificates, and diplomas given to the club members are often more appreciated than money and expensive premiums. The same badge or emblem used by canning club members will be used by members of the poultry club. When liberal amounts are offered for prizes, it will be well to give them in every township or school district, and offer premiums to the club that will make the highest records with 5 or 10 in a team, dividing this premium into several different awards, depending upon the rank.

FOUR YEARS' WORK FOR POULTRY CLUBS.

FIRST YEAR.

Each member shall set at least three sittings of eggs from pure-bred stock, and raise seven pullets and one cockerel. All hatching must be completed by May 15. A composition on poultry management must be submitted to the agent in charge of club work. Accurate records are also to be kept and sent to the above-mentioned official, and all meetings of the poultry club must be attended.

SECOND YEAR.

Each member shall raise at least 15 pure-bred pullets and 2 cockerels. All hatching must be completed by May 10. A pair of birds and one dozen eggs from this stock shall be exhibited at the county or State fair. A composition on some phase of poultry work shall be submitted to the agent in charge of club work. Accurate records are also to be kept and sent to the above-mentioned official, and all meetings of the poultry club must be attended.

THIRD YEAR.

Each member shall raise at least 25 pure-bred pullets and 2 cockerels. All hatching must be completed by May 1. A pair of birds and one dozen eggs from this stock shall be exhibited at the county or State fair. A composition on some phase of poultry work shall be submitted to the agent in charge of club work. Accurate records are also to be kept and sent to the above-mentioned official, and all meetings of the poultry club must be attended.

FOURTH YEAR.

Each member shall raise at least 30 pure-bred pullets and 3 cockerels. All hatching must be completed by May 1. A pair of birds and one dozen eggs from this stock shall be exhibited at the county or State fair. A composition on some phase of poultry work shall be submitted to the agent in charge of club work. Accurate records are also to be kept and sent to the above-named official, and all meetings of the poultry club must be attended.

The hatching and rearing of the chickens; the condition of chickens and cleanliness of coops and poultry buildings; the cost of producing eggs; accuracy and neatness of records; attendance at meetings; exhibits at the fairs; and written articles on poultry work shall be considered in rating members and awarding prizes.

PUBLICATIONS.

The following publications will undoubtedly be of some assistance to club members in their poultry operations, and will be sent free upon application to the Secretary of Agriculture, Washington, D. C.:

Farmers' Bulletin 22. The Feeding of Farm Animals.
Farmers' Bulletin 51. Standard Varieties of Chickens.
Farmers' Bulletin 177. Squab Raising.
Farmers' Bulletin 200. Turkeys.
Farmers' Bulletin 234. The Guinea Fowl.
Farmers' Bulletin 236. Incubation and Incubators.
Farmers' Bulletin 287. Poultry Management.
Farmers' Bulletin 374. Experiment Station Work. (Colony Houses.)
Farmers' Bulletin 390. Pheasant Raising in the United States.
Farmers' Bulletin 528. Hints to Poultry Raisers.
Farmers' Bulletin 530. Important Poultry Diseases.

MANAGEMENT OF FLOCKS.

HOUSING THE POULTRY.

On almost any farm there can be fitted up, with very little, if any, cost for new material, a poultry house that will answer all the purposes of more expensive buildings for keeping poultry. The essentials to success in housing are fresh air, sunshine, a dry floor, and a building that is free from drafts. In constructing a poultry house it is advisable to allow from 2½ to 4 square feet of floor space per bird.

Figure 3 gives a plan for a poultry house 10 by 14 feet in size for not more than 50 hens which can be constructed at an expense of about $20 for material. This house has one-half of the front open, and is adapted for southern conditions, but in localities where much snow or rain is apt to blow into the house or where the winters are severe it is advisable to insert a curtain of burlap or thin muslin which can be closed in cold weather. If the ground is damp, it will be necessary to add a board floor; otherwise a dirt floor elevated a few inches above the ground level will be satisfactory. If desired, a cement floor of cheap and simple construction may be laid; such a floor is a good protection against rats. The plan shows a 6-inch shutter on the back just under the eaves, which is recommended for use in the South. This must be constructed so that it can be closed to prevent any draft on the hens in cold weather. The house should face toward the south. The nests may be placed directly under the dropping boards or on the walls of the house rather than on the floor.

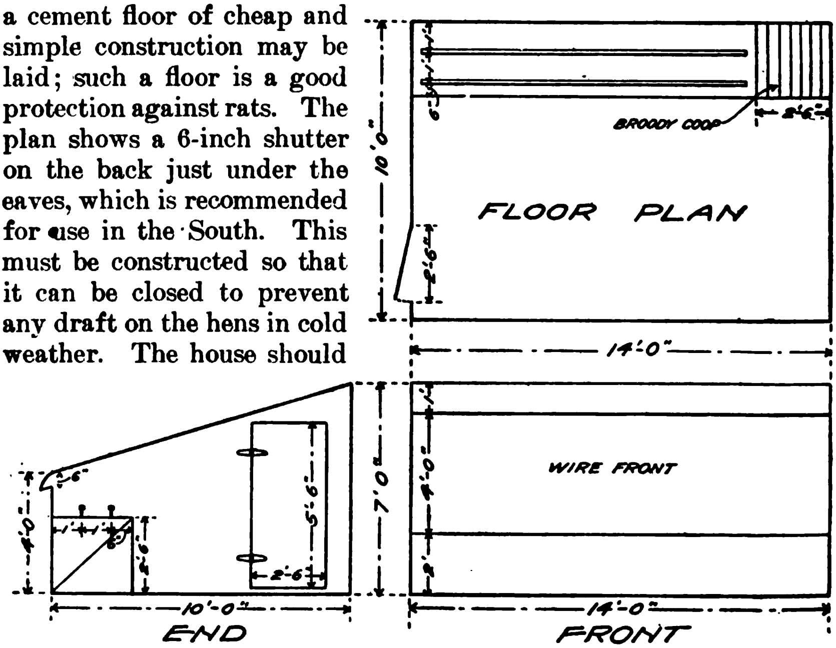

FIG. 3.—Plan of an inexpensive poultry house.

The materials required for building the house shown in figure 3 are as follows:

Two pieces 4 by 4 inches by 10 feet, for sills.
Two pieces 4 by 4 inches by 14 feet, for sills.
Two pieces 2 by 4 inches by 10 feet, for plates.
Two pieces 2 by 4 inches by 14 feet, for plates.
Sixteen pieces 2 by 4 inches by 12 feet, for studs, rafters, and roosts.
One hundred and twenty square feet of boards 12 feet long, for ends.
Fifty-six square feet of boards for back.
Eighty-four square feet of boards for front and dropping boards.
One hundred and fifty square feet of boards for roof.
Two hundred and twelve linear feet of 2 by ½ inch battens.
Total scantling, 226 feet b. m.
Total boards, 622 feet b. m.
Total lumber, 850 feet b. m.

Two pairs hinges.
One hundred and fifty square feet roofing paper.
Nails.
Fifty-six square feet poultry wire, 2-inch mesh.

Poultry netting, ¾-inch mesh, can be used in localities where sparrows are troublesome.

Figure 4 shows a larger house of the same style of construction.

The foregoing plans for housing are merely suggestive, and any plan that conforms generally to the essentials laid down will be sufficient.

SELECTION OF STOCK.

The selection of stock is a matter of considerable importance, as a great deal of one's success or failure with poultry depends upon the individual specimens used to breed from. Care should be taken to select the early maturing, fast-growing pullets. Hens will not, as a rule, lay until they are well matured; consequently it can be readily seen that the slow-growing breeds will not begin to lay as soon as the former. A good index to a hen's ability to pay a profit over the cost of feed and labor is her ability to be continually on the move. It is advisable to keep but one breed of pure-bred fowls, as the product from a flock of the same variety is more uniform than that from a flock of mixed breeds or mongrel stock. It is advised that all pullets to be used as layers the following winter shall be hatched by April 15, and certainly not later than May 1 of the preceding spring.

FEEDING THE FLOCK.

It takes a healthy, well-fed flock to produce eggs. Fowls must not be allowed to become too fat, as but few eggs will be laid by hens in such condition. To prevent their getting overfat, it is best to make them work for most of their feed by scratching in the litter, of which there should be about 4 inches on the floor. This litter can be of straw, leaves, or chaff, and should always be kept dry.

A good feed for egg production is one composed of corn, wheat, and oats, equal parts by measure. It is advisable to use home-grown grains whenever possible. In sections where corn and oats do not thrive, other grains can be used to good advantage; for example, a mixture of equal parts by measure of kafir corn, oats, and barley will produce good results. Scatter a small handful of this mixture for every three hens in the litter morning and noon, and give them all they will eat of it in a V-shaped trough at night. In the wintertime some green feed should be fed at noon; cabbage or mangel-wurzels, either chopped or whole, are good. Every few days look in the litter carefully and see if the fowls are eating all the grain being given them; if not, reduce the quantity. Fowls that have to work for what feed they get seldom become overfat. Grit and oyster shells in a hopper should always be kept before them. The grit is used to grind their feed, and the oyster shell furnishes the lime for the eggshells. Be sure to keep water before them at all times. Birds that are laying drink much more water than those that are not laying. The water should be kept out of the direct rays of the sun. During the fall and winter months, when colds and roup are apt to appear among the poultry, it is advisable to add the amount of permanganate of potash which will remain on the face of a 10-cent piece to each gallon of drinking water. This mixture will often prevent and cure these troubles. Allow the fowls free range whenever possible, except when snow is on the ground.

METHODS OF HATCHING.

The period of time it takes to hatch eggs of the domestic hen is 21 days. There are two methods of incubation and brooding, namely, natural and artificial. In natural incubation and brooding the hen is allowed to sit on a nest of eggs and brood or mother the young chicks when hatched. The information contained on this subject is based on the belief that the average farmer has little use for an incubator or brooder unless he intends to hatch and rear chicks unusually early in the spring or in large numbers; therefore only the natural method of incubation and brooding will receive attention at this time.

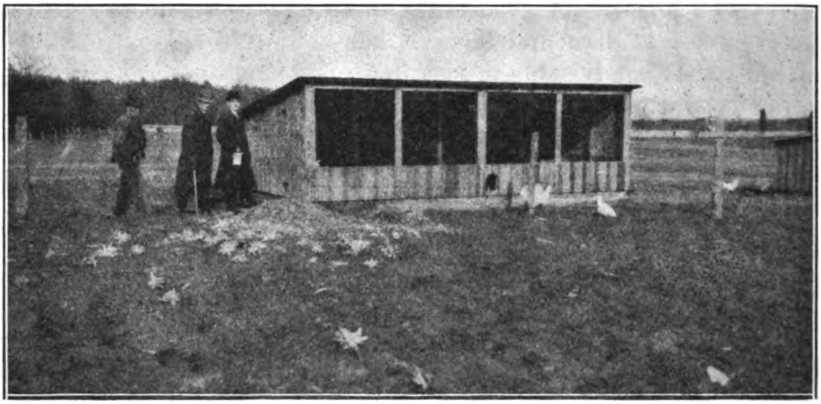

FIG. 4.—Open-front poultry house.

HOW TO SET A HEN AND HER CARE WHILE SITTING.

As the time approaches for the hens to become broody or sit, if care is taken to look in the nests it will be seen that there are a few soft downy feathers being left there by the hens; also, the hens stay longer on the nests when laying at this time, and on being approached will quite likely remain on the nest, ruffling up their feathers and pecking at the intruder. When it is noted that a hen sits on the nest for two or three nights in succession, she is ready to be transferred to a nest which should be prepared for her before-hand. This nest should be in a box and composed of straw, hay, or chaff for nesting material. Pack this material down firmly and shape a circular nest out of it which should be slightly deeper in the center than at the edges, as a nest so shaped will prevent the eggs from rolling out from under the hen and becoming chilled. Dust the hen thoroughly with insect powder. In applying the powder, hold the hen by the feet, head down, working the powder well into the feathers, giving special attention to regions around the vent and under the wings. The powder should also be sprinkled in the nest. The nest should be in some quiet, out-of-the-way place on the farm, where the sitting hen will not be disturbed. Move her from the regular laying nest at night. Handle her carefully in doing so. Put a china egg or two in the nest where she is to sit, and place a board over the opening so that she can not get off. Toward evening of the second day, quietly go in where she is sitting, and leave some feed and water, and remove the board from the front or top of the nest and let the hen come off when she is ready. Should she return to the nest after feeding, remove the china egg or eggs and put under those that are to be incubated. In cool weather it is best to put not more than 10 eggs under a hen, while later in the spring one can put 12 to 15, according to the size of the hen. If several hens are sitting in the same room, see that they are kept on the nests, only allowing them to come off to get feed and water, which should be once a day.

TESTING THE EGGS.

Many eggs that are laid in the late winter and early spring are infertile. For this reason it is advisable to set several hens at the same time. After the eggs have been under the hen for seven days they should be tested to see whether they are fertile or infertile. Infertile eggs should be removed and used at home in cooking or for omelets, and the fertile eggs should be put back under the hen. In this way it is often possible to put all the eggs that three hens originally started to sit on under two hens and reset the other hen again. For example: Thirty eggs are set under three hens at the same time, 10 under each. At the end of 7 days we find on testing the eggs that 10 are infertile, which leaves us 20 eggs to reset, which we do by putting them under two hens and have the remaining one to set over again after she has set only 7 days.

A good homemade egg tester or candler can be made from a large shoe box or any box that is large enough to go over a lamp by removing an end and cutting a hole a little larger than the size of a quarter in the bottom of the box, so that when it is set over a common kerosene lamp the hole in the bottom will be opposite the blaze. A hole the size of a silver dollar should be cut in the top of the box to allow the heat to escape. (See fig. 5.) An infertile egg, when held before the small hole with the lamp lighted inside the box, will look perfectly clear, the same as a fresh one, while a fertile egg will show a small dark spot, known as the embryo, with a mass of little blood veins extending in all directions if the embryo is living. If dead, if the egg has been incubated for at least 36 hours, the blood settles away from the embryo toward the edges of the yolk, forming in some cases an irregular circle of blood, known as a blood ring. Eggs vary in this respect, some showing only a streak of blood. The testing should be done in a dark room.

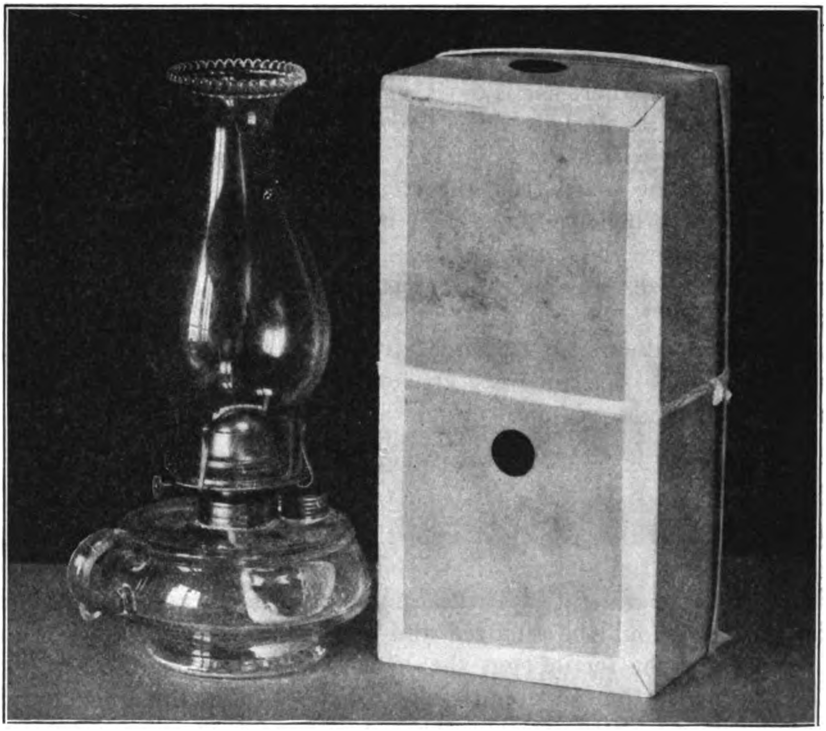

FIG. 5.—A homemade egg tester.

MARKETING EGGS.

When ready to sell the eggs grade them according to size and color. Make them into the following classes: Large white eggs, large brown eggs, small white eggs, and small brown eggs. A uniform lot will, as a rule, command a higher price than a mixed one. When taking them to town keep them covered and out of the direct rays of the sun. The following rules should be followed in the care of eggs:

1. Keep the nests clean; provide one nest for every four hens.
2. Gather the eggs twice daily.
3. Keep the eggs in a cool, dry room or cellar.
4. Market the eggs at least twice a week.

PRODUCE INFERTILE EGGS.

An infertile egg is one that is laid by a hen that has not been allowed to run with a male bird, or by a hen from which a male bird has been separated from seven days to three weeks. Experiments have shown that the time varies. In most cases, however, 14 days is long enough to wait for the eggs to become infertile after the male bird is removed from the females. It is impossible to hatch an infertile egg or to cause a blood ring to form in one. It also keeps in good condition in temperatures that will cause fertile eggs to rot.

A fertile egg is just the opposite of the infertile in many respects. It is the egg that is produced from hens that are running with male birds, although occasionally there are hens running with male birds that lay infertile eggs. This is often the case with hens that are confined in yards and runs, and birds that do not have green feed, or those that are overfat. The fertile egg is the egg from which the chick is hatched, and the egg that spoils so quickly when subjected to the ordinary methods of handling on the farm and when marketed in the hot summer months under adverse conditions.

When eggs are not desired for hatching purposes, produce the infertile egg. Hens will lay as many eggs without having a male bird with them as they will if allowed to run with one. Sell, kill, or confine all male birds as soon as the hatching season is over.

DISPOSITION OF SURPLUS BIRDS.

When the young chicks are hatched they should be marked in some way, so that it can be known just what pen or pens they are from, if birds from certain pens are to be kept for breeding or other purposes; also to be able to tell the year in which the birds are hatched. A good method of marking the chicks is to punch a small hole in the web of the foot between the toes with a harness punch, using the small-size punch. Figure 6 shows a system of marking with 16 different combinations that can be used for this purpose.

It is advisable to market the old hens in the summer as soon as the second laying season is over, as hens over 2 years old rarely lay as many eggs as they do in their pullet and yearling seasons. If they have been toe-punched, it will be an easy matter to tell exactly in what year they were hatched. Before sending the old hens, males, and young cockerels to market, they should be confined in a small pen for at least two weeks, to increase their weight and put on fat, and should be given all the feed they will consume of a mixture of 2 parts corn meal, 1 part middlings or low-grade flour, and 1 part bran, adding enough water to make a crumbly mash. Water or skim milk should also be kept before them during this fattening period.

SUGGESTION TO MEMBERS.

To rid the poultry house of mites, spray the pen, the roosts, and the dropping boards with kerosene or crude petroleum at least once a week from the time warm weather sets in in the spring until cold weather comes in the fall. Those having lime and sulphur compound could use it to good advantage for destroying lice and mites in the poultry house.

Market all cockerels, except those intended for breeding purposes, as soon as they attain broiler size, for they will pay a larger profit at that time than if held until fall when the market becomes overcrowded.

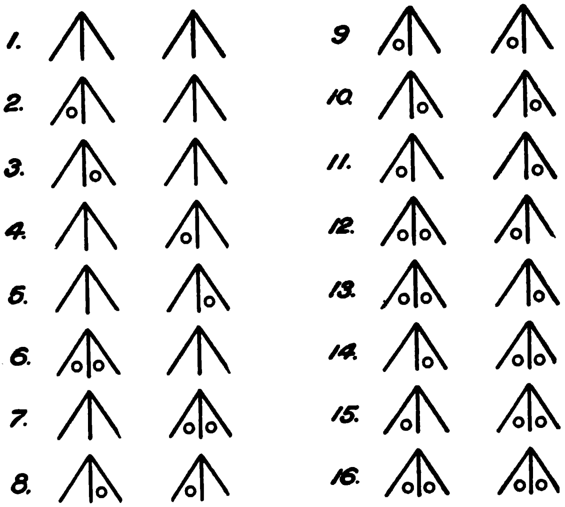

FIG. 6.—Toe marks for chicks.

It is urged that club members strictly adhere to the following rules in handling their poultry and eggs:

1. Keep the nests clean; provide one nest for every four hens.
2. Gather the eggs twice daily.
3. Keep the eggs in a cool, dry room or cellar.
4. Market the eggs at least twice a week.
5. Sell, kill, or confine all male birds as soon as the hatching season is over.

The work of organizing the boys' and girls' poultry clubs herein described is to be conducted by the Bureau of Animal Industry in cooperation with the Farmers' Cooperative Demonstration Work and with the Office of Farm Management of the Bureau of Plant Industry.

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U.S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN
563

Contribution from the Bureau of Statistics.
November. 11, 1913.

UNIVERSITY
GENERA

THE AGRICULTURAL OUTLOOK.

CROP PRODUCTION IN UNITED STATES.

The figures given in this report are estimates based upon information from the most reliable sources obtainable and are believed to be as nearly accurate as can be expected without an actual enumeration.

A general summarization of crop yields per acre in the United States indicates a combined estimated average of about 13.1 per cent smaller than last year and about 6.3 per cent smaller than the estimated average yields of the last 10 years. The final outcome of crops appears to be somewhat better than the earlier condition figures indicated.

It is estimated that the general level of farm prices of staple crops decreased 3.7 per cent from October 1 to November 1. Almost every year there is a reduction in the price level from October 1 to November 1, the average reduction during the period of the preceding five years having been 4.4 per cent. The average level of prices of crops on November 1 was 13.2 per cent higher than on November 1 last year, 1.8 per cent lower than two years ago (a year in which crops were smaller than this year), and 9.5 per cent higher than the average of the last five years on November 1.

The estimated average farm price of meat animals (beef cattle, veal calves, hogs, sheep, lambs, and chickens) on October 15 was about $7.12 per 100 pounds, which compares with $7.15 on September 15, $6.86 a year ago, $5.58 two years ago, and $6.80 three years ago. From September 15 to October 15 the price level decreased 0.5 per cent, which compares with an increase of 1.8 per cent during the same period a year ago, a decrease of 5 per cent two years ago, and a decrease of 1.7 per cent three years ago.

The estimated average of yields this year of all crops combined, duly weighted by States, compared, first, with last year and, second, with the average yields of recent years, is given on page 2.

Estimated average of yields of all crops combined, by States.

States.	Production, 1913, compared—		States.	Production, 1913, compared—		States.	Production, 1913, compared—	
	With 1912.	With average.		With 1912.	With average.		With 1912.	With average.
	P. ct.	*P. ct.*		*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*
Maine	101	102	Ohio	91	97	Texas	95	103
New Hampshire	77	89	Indiana	93	95	Oklahoma	57	62
Vermont	85	98	Illinois	73	80	Arkansas	95	95
Massachusetts	91	96	Michigan	93	94	Montana	91	94
Rhode Island	103	101	Wisconsin	101	110	Wyoming	96	92
Connecticut	94	96	Minnesota	98	115	Colorado	91	89
New York	87	91	Iowa	83	102	New Mexico	86	84
New Jersey	95	101	Missouri	66	71	Arizona	109	116
Pennsylvania	90	98	North Dakota	70	98	Utah	91	92
Delaware	89	97	South Dakota	73	82	Nevada	92	105
Maryland	87	93	Nebraska	83	78	Idaho	97	102
Virginia	107	107	Kansas	55	61	Washington	96	101
West Virginia	78	93	Kentucky	82	83	Oregon	91	105
North Carolina	102	104	Tennessee	89	88	California	90	88
South Carolina	104	106	Alabama	99	101			
Georgia	107	104	Mississippi	101	99	United States	87	94
Florida	104	111	Louisiana	104	102			

The Crop Reporting Board of the Bureau of Statistics (agricultural forecasts) of the United States Department of Agriculture estimates, from the reports of the correspondents and agents of the Bureau, as follows:

Preliminary estimates for the United States of products of important crops in 1913, with comparisons.

Crops.	Yield per acre.			Production (000 omitted).		Price Nov. 1.	
	1913	1912	10 years.	1913	1912	1913 [1]	1912 [1]
Corn ... bushels	23	29	27	2,463,017	3,124,746	70.7	58.4
Buckwheat ... do	17	23	20	14,455	19,249	75.5	65.5
Potatoes ... do	89	113	96	328,550	420,647	69.6	45.5
Sweet potatoes ... do	95	95	91	55,760	55,479	....	....
Flaxseed ... do	8	10	9	19,234	28,073	118.7	133.4
Tobacco ... pounds	790	786	824	903,875	962,855	....	....
Wheat ... bushels	15	16	14	753,233	730,267	77.0	83.8
Oats ... do	29	37	30	1,122,139	1,418,337	37.9	33.6
Barley ... do	24	30	26	173,301	223,824	54.7	53.8
Rye ... do	16	17	16	34,789	35,664	63.2	68.8
Hay ... tons	1.31	1.47	1.43	63,460	72,691	12.26	11.80

[1] Hay, dollars per ton; other products, cents per bushel.

The production of various products, expressed in percentages of a "full crop" in the past three years, is estimated in the table on page 3, from reports of agents and correspondents of the Bureau of Statistics (agricultural forecasts).

Estimated production of miscellaneous crops, three years, expressed in percentages of full crop.

Crop.	1913	1912	1911	Crop.	1913	1912	1911
Fruits:				Vegetables—Continued.			
Apples	45	70	62	Cauliflower (California)	90	90	......
Apricots (California)	61	80	75	Celery (California)	92	96	......
Blackberries	75	72	68	Onions	78	91	76
Cantaloupes	78	80	78	Tomatoes	77	85	77
Cranberries	70	79	71	Miscellaneous:			
Grapefruit (Florida)	80	105	57	Alfalfa	83	94	87
Grapes	73	88	82	Alfalfa seed	89	84	......
Lemons	65	95	91	Almonds (California)	50	81	62
Limes (Florida)	90	75	75	Broom corn	50	83	70
Oranges	82	102	84	Clover hay	81	83	57
Peaches	48	68	44	Clover seed	81	75	56
Pears	57	74	71	Hemp	55	77	65
Pineapples (Florida)	88	92	75	Kafir corn—			
Prunes (California)	63	88	80	Grain	53	156	78
Raspberries	73	77	72	Forage	55	89	79
Strawberries	74	89	69	Millet hay	62	86	71
Watermelons	76	81	80	Millet seed	62	80	64
Vegetables:				Olives (California)	76	64	87
Beans—				Peanuts	84	82	81
Dry	76	88	77	Sugar beets	89	101	100
Lima	77	83	78	Sugar cane	85	76	97
Cabbages	71	91	73	Walnuts (California)	77	86	80

CORN.

The information gathered by the bureau November 1 justifies the preliminary estimate of a yield of 23 bushels per acre on the planted area of 106,884,000 acres, which indicates a total production of 2,463,017,000 bushels, which, while approximately 660,000,000 bushels less than last year's record crop and the lowest since 1903, is but 60,000,000 bushels less than the short crop of 1911. The yield per acre is 6.2 bushels less than last year, 0.9 less than 1911, and the lowest since 1901, when it touched 16.7, the record low yield.

A gratifying development is the increased yields over propects a month ago, reported quite generally for the main corn belt outside the seriously drought-stricken districts and reflected in the substantial gain of about 90,000,000 bushels over the production indicated October 1.

While the present production, compared with that of last year, is only about one-seventh in Kansas, slightly over half in Missouri and Oklahoma, nearly two-thirds in Nebraska, Illinois, and Kentucky, and four-fifths in Iowa, Ohio, and Tennessee, farther north in the Central States and throughout the South Atlantic and Gulf States the production was as large or larger than last year.

The percentage of the heavy crop of 1912 remaining on farms November 1 is estimated at 4.4 per cent (137,972,000 bushels) against 2.6 per cent (64,764,000 bushels) of the light crop of 1911 on farms on November 1 last year, and a 10-year average of 3.8 per cent.

The quality is estimated at 82 for the United States, compared with 86 in 1912, 81 in 1911, and a 10-year average of 86; ranging from 47 in Kansas, the State most injured by drought, to 94 in Minnesota.

Farm prices were higher than last year in all important corn States, being 71 for the United States, against 75 October 1, 58 November 1, 1912, and a five-year average of 60. In the central corn States, which suffered from drought, prices range from 60 in Iowa to 79 in Kansas, against 50 or slightly over in 1912.

BUCKWHEAT.

The information gathered by the bureau indicates a yield per acre of 17 bushels, against 23 in 1912 and a 10-year average of 20, which would give upon the planted area of 841,000 acres (same as 1912) a total production of 14,455,000 bushels, against 19,249 in 1912, being the smallest since 1907, a result of dry weather and early frosts in New York and Pennsylvania.

The price paid producers November 1 was 75.5, compared with 74.1 October 1, 70 September 1, 65.5 November 1, 1912, and a five-year average that date of 70.6.

FLAXSEED.

The bureau estimates a yield of 7.9 bushels against 9.8 in 1912 and a 10-year average of 9, indicating a total production on the 2,425,000 acres planted of 19,234,000 bushels, against 28,073,000 in 1912. The acreage is estimated at 15 per cent less than last year.

The average price paid producers November 1 was 1.19 compared with 1.23 October 1, 1.33 November 1, 1912, and a five-year average of 1.64 on that date.

TOTAL UNITED STATES PRODUCTION OF CEREALS.

The comparative production of edible cereals for several years is shown below, reduced to pounds for the purpose of securing an aggregate:

Comparative production of edible cereals in United States, five years, and average in millions of pounds.

Cereal.	1913	1912	1911	1910	1909[1]	Average.
Corn	137,929	177,986	141,763	161,531	142,923	152,426
Wheat	45,194	43,816	37,280	38,107	41,001	41,080
Oats	35,908	45,387	29,514	37,963	32,228	36,200
Barley	8,318	10,744	7,692	8,344	8,319	8,683
Rye	1,948	1,997	1,855	1,954	1,653	1,881
Rice	1,125	1,127	1,032	1,103	1,097	1,097
Buckwheat	694	954	842	845	713	804
Total	231,116	282,011	219,978	249,847	227,934	242,171

[1] Census.

COTTON.

The Department of Agriculture makes no report in November on cotton condition or production. An estimate of this years' production will be issued on Friday, December 12.

The following table gives the price per pound paid to producers on November 1 of recent years and the census report of the quantity ginned prior to November 1 of the last four years, by States:

Cotton acreage, price and quantity ginned as of dates indicated.

	Prelimi-nary area, 1913 (000 omitted).	Price per pound Nov. 1.				Price Oct. 1, 1913.	Ginned prior to Nov. 1, running bales, counting round as half, 000 omitted; from census.			
		1913	1912	1911	5-year aver-age.		1913	1912	1911	1910
	Acres.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bales.*	*Bales.*	*Bales.*	*Bales.*
Virginia	50	13.1	11.0	9.5	11.6	......	......	......	......	......
North Carolina	1,560	13.5	10.7	8.8	11.2	13.2	385	497	598	386
South Carolina	2,716	13.4	11.0	8.8	11.3	13.3	861	731	1,023	729
Georgia	5,336	13.5	10.8	8.8	11.3	13.3	1,602	1,112	1,909	1,242
Florida	230	15.3	15.0	12.3	15.0	13.7	47	35	56	39
Alabama	3,804	13.4	10.7	8.7	11.2	13.3	1,013	810	1,089	749
Mississippi	3,045	13.5	11.3	9.4	11.6	13.3	568	512	584	577
Louisiana	1,166	13.2	10.3	9.2	11.1	13.1	222	262	232	155
Texas	11,732	12.5	10.8	8.7	11.1	13.3	2,950	3,710	3,212	2,405
Arkansas	2,117	12.9	11.2	9.1	11.4	13.2	431	440	441	325
Tennessee	823	13.5	11.5	9.0	11.3	13.4	174	118	211	130
Missouri	113	11.5	9.0	9.5	10.5	13.0	568	512	584	577
Oklahoma	2,916	12.5	10.6	8.9	10.8	13.1	536	599	555	585
California	14	......	......	......	......	......	......	......	......	......
United States	35,622	13.0	10.9	8.9	11.2	13.3	8,836	8,869	9,971	7,346

TOBACCO.

Preliminary estimates indicate a total production of 903,875,000 pounds of tobacco, which is 59,010,000 pounds, or 6.1 per cent less than last year's estimate. The States producing cigar tobacco, with the exception of Georgia and Florida, show a falling off in both yield per acre and total production. Serious loss was suffered from an early frost in Ohio, New York, and the northern counties in Pennsylvania. Of the States which produce chewing, smoking, snuff, and export types, Maryland, Virginia, North Carolina, South Carolina, and Tennessee show an increased yield per acre; all the others show a falling off.

The average quantity for the entire crop is 85, compared with 88 last year and a ten-year average of 87. In the important States producing cigar tobacco the quality is inferior to the 1912 crop. Of the States growing chewing, smoking, snuff, and export types, Virginia, South Carolina, and Louisiana show higher quality than last year. North Carolina and Tennessee show the same, while all others show lower quality.

Dry weather prevailed during most of the growing season in the New England States, New York, Pennsylvania, Ohio, Indiana, West Virginia, Kentucky, and Tennessee, making the yield per acre below the ten-year average and below last year's in all except Tennessee, where last year's yield was unusually light. In western Kentucky and Tennessee late August and September rains caused rapid improvement in the crop, resulting in a better yield than usual. The Maryland crop suffered from drought during the early summer months, but the dry condition was relieved in time to make a good yield. In Virginia, North Carolina, South Carolina, Georgia, and Florida conditions were favorable for a good yield. Wisconsin suffered from dry weather in the early part of the growing season, causing the crop to get a late start. Conditions later were favorable, but the crop did not fully recover from early damage.

HOPS CONSUMPTION.

The total hop movement of the United States for the past 7 years is shown in the following table. The figures on the quantity consumed by brewers have been compiled from records of the Treasury Department.

Hop consumption and movement in years indicated.

Year ended June 30—	Consumed by brewers.	Exports.		Total of brewers' consumption and exports.	Imports.	Net domestic movement.
		Domestic.	Foreign.			
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1913	44,237,735	17,591,195	35,859	61,864,789	8,494,144	53,370,645
1912	42,436,665	12,190,663	35,869	54,663,197	2,991,125	51,672,072
1911	45,068,811	13,104,774	17,974	58,191,559	8,557,531	49,634,028
1910	43,293,764	10,589,254	14,590	53,897,608	3,200,560	50,697,048
1909	40,813,804	10,446,884	26,197	51,286,885	7,386,574	43,900,311
1908	42,988,257	22,920,480	94,631	66,003,368	8,493,265	57,510,103
1907	44,294,839	16,809,534	8,714	61,113,087	6,211,893	54,901,194
1906	41,620,172	13,026,904	32,454	54,679,530	10,113,989	44,565,541

The production of hops in the United States this year is somewhat larger than last year, but, owing to a shortage in Europe, prices are ruling as high as a year ago. On October 15 the average price paid producers in the United States was about 21 cents a pound.

CABBAGES.

The marked shortage of the cabbage crop in the surplus sections of the northern States is already reflected in the high prices prevailing. Special reports from producing regions of New York, the largest producing State, indicate that the ruling price recently was about $19.40 per ton, whereas a year ago, with an oversupply, the price averaged only about $4.10 per ton. These special reports indicate that the yield per acre is only about 6 tons as against 13.5 tons last year, on about 15 per cent smaller acreage. In Ohio the yield is about 6.4 tons, against 13.5 tons last year, on a moderately reduced area; the price is about $18 per ton, against about $4.79 a year ago. In Michigan the yield per acre is about 6.7 tons, against 10.9 last year, on about 10 per cent smaller area; price about $13.30, against $6.20 a year ago. In Wisconsin the yield per acre is about 10.1 tons, against 12.8 last year, on a moderately reduced area; price about $13.70, against about $5 a year ago. In Minnesota the yield per acre is about 10.8 tons, against 12.2 tons last year, on about the same acreage; the prevailing price is about $15.90 per ton, against $4.40 last year. It thus appears from these special reports that the surplus supply is only moderate, and that prices are well maintained.

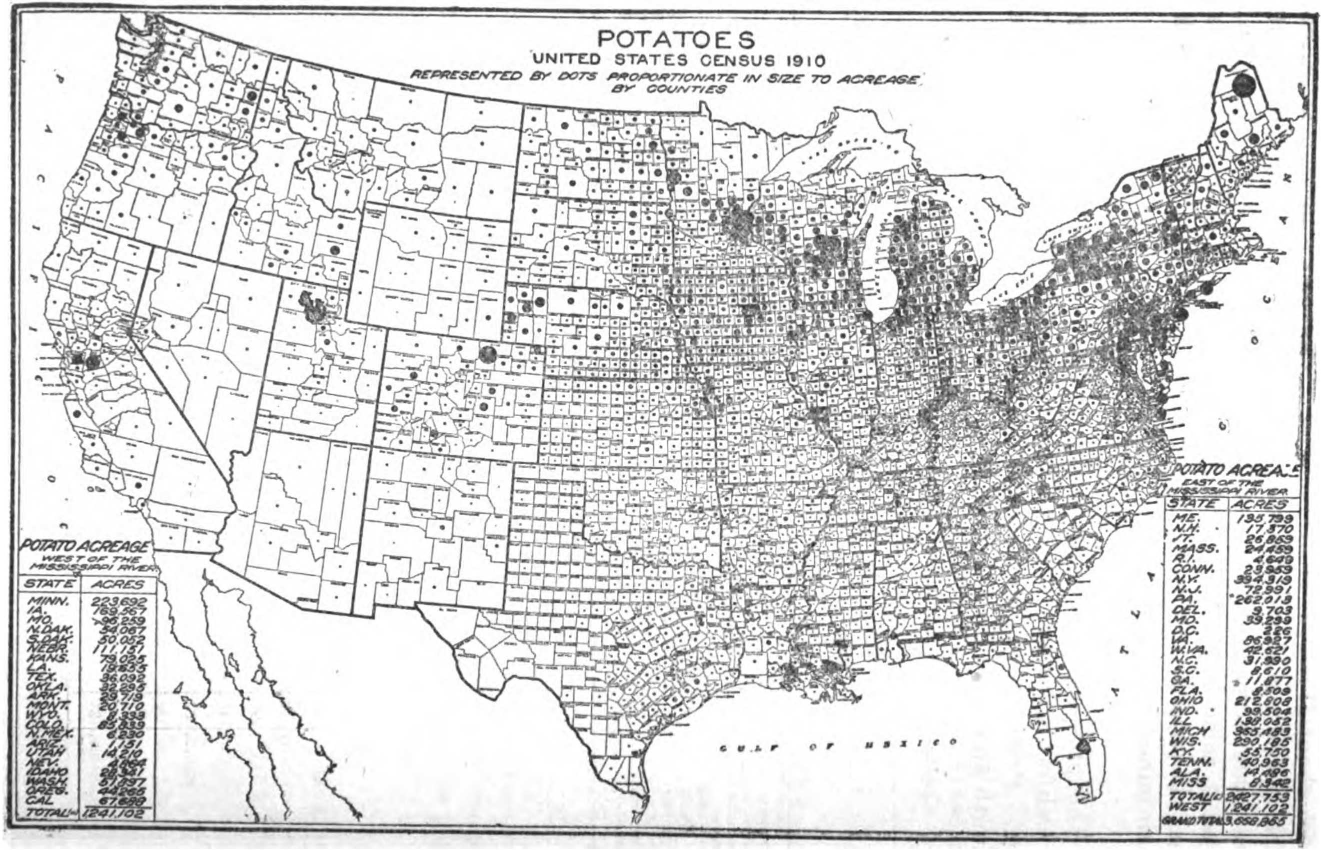
SUBTROPICAL FRUITS AND NUTS.

The prospects for subtropical fruits and nuts improved slightly in California during October; they are, however, much below the average. Prospects in Florida have not changed materially during the month and generally are good.

Condition of subtropical fruits and nuts in California and Florida on Nov. 1.

Crop.	California.			Florida.		
	1913	1912	1911	1913	1912	1911
Almonds [1]	50	81	62	....	....	....
Olives	76	72	90	....	....	....
Walnuts [1]	77	86	80	....	....	....
Grapes:						
Raisin [1]	79	88	82	....	....	....
Table	84	89	92	....	....	....
Oranges	80	90	93	88	100	75
Lemons	65	92	94	....	90	73
Grapefruit	....	....	....	80	95	62
Limes	....	....	....	90	85	83

[1] Production compared with a full crop.


POTATOES
UNITED STATES CENSUS 1910
REPRESENTED BY DOTS PROPORTIONATE IN SIZE TO ACREAGE BY COUNTIES
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO

POTATO ACREAGE
WEST OF THE MISSISSIPPI RIVER

STATE	ACRES
MINN.	223,692
IA.	169,567
MO.	96,259
N.DAK.	54,067
S.DAK.	50,052
NEBR.	111,151
KANS.	79,025
LA.	19,535
TEX.	36,092
OKLA.	32,295
ARK.	29,719
MONT.	20,710
WYO.	8,333
COLO.	85,839
N.MEX.	6,230
ARIZ.	1,151
UTAH	14,210
NEV.	4,664
IDAHO	28,321
WASH.	51,897
OREG.	44,266
CAL	67,699
TOTAL	1,241,102

POTATO ACREAGE
EAST OF THE MISSISSIPPI RIVER

STATE	ACRES
ME.	135,799
N.H.	17,370
VT.	26,859
MASS.	24,459
R.I.	4,649
CONN.	23,959
N.Y.	394,319
N.J.	72,991
PA.	262,013
DEL.	9,703
MD.	39,299
D.C.	226
VA.	86,927
W.VA.	42,621
N.C.	31,990
S.C.	8,610
GA.	11,877
FLA.	8,509
OHIO	212,808
IND.	99,504
ILL	138,052
MICH	355,483
WIS.	290,185
KY.	55,750
TENN.	40,963
ALA.	14,486
MISS	8,342
TOTAL	2,427,753
WEST	1,241,102
GRAND TOTAL	3,668,855

Corn crop: Estimates based upon returns to Nov. 1, with details by States, with comparisons.

States.	Corn.											
	Yield per acre.			Production (000 omitted).			Old corn on farms.		Quality.	Price.		
	1913	1912	10-year average.	1913	1912	1911	1913	1912 (000 omitted).	Per cent of average.	Oct. 1, 1913.	Nov. 1, 1913.	Nov. 1, 1912.
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*P. ct.*	*Bu.*		*Cts.*	*Cts.*	*Cts.*
Maine	38	40	39	608	640	792	1.4	11	83	90	81	85
New Hampshire	37	46	37	814	1,058	1,035	1.5	13	81	83	83	81
Vermont	37	40	37	1,702	1,800	1,886	2.4	45	77	84	81	81
Massachusetts	41	45	39	1,944	2,115	2,068	2.1	21	86	80	82	80
Rhode Island	37	42	36	402	456	495	4.5	18	82	106	107	100
Connecticut	39	50	41	2,348	3,000	2,862	2.2	37	87	88	84	80
New York	29	39	34	15,020	19,763	20,406	2.4	367	80	84	80	76
New Jersey	40	38	35	10,665	10,374	9,936	5.0	447	100	85	83	74
Pennsylvania	39	43	38	56,326	61,582	63,858	4.0	2,554	98	83	76	70
Delaware	32	34	31	6,206	6,630	6,630	4.0	192	93	68	57	60
Maryland	33	37	34	22,341	24,455	24,455	2.7	514	94	77	68	61
Virginia	26	24	24	51,480	47,520	47,520	3.5	1,426	100	85	78	76
West Virginia	31	34	28	22,692	24,505	18,170	3.8	382	101	85	81	72
North Carolina	20	18	17	55,302	51,106	49,680	3.4	1,590	102	96	90	85
South Carolina	20	18	15	38,844	34,278	32,578	3.0	1,108	102	103	102	96
Georgia	16	14	13	63,023	53,958	59,072	1.7	1,241	102	96	93	92
Florida	15	13	12	10,125	8,515	9,286	0.5	56	108	80	82	87
Ohio	38	43	37	149,775	174,410	150,540	4.5	4,215	100	72	64	56
Indiana	36	40	37	176,328	199,364	174,600	5.5	4,889	98	71	64	53
Illinois	27	40	36	284,877	426,320	334,950	5.7	10,383	88	71	64	50
Michigan	34	34	33	54,974	55,250	55,770	3.5	1,673	104	71	70	63
Wisconsin	41	36	34	66,096	58,262	58,080	3.6	1,162	108	63	60	55
Minnesota	40	35	31	94,280	78,177	74,140	3.3	2,224	113	61	53	48
Iowa	34	43	34	338,198	432,021	305,350	5.5	8,855	101	66	60	50
Missouri	18	32	30	129,378	243,904	192,400	6.5	4,618	77	78	75	50
North Dakota	29	27	24	9,821	8,758	7,250	1.0	72	114	53	47	48
South Dakota	26	31	29	66,810	76,347	50,820	3.5	762	105	61	58	41
Nebraska	15	24	27	114,135	182,616	155,925	3.6	2,495	91	71	68	52
Kansas	3	23	22	23,757	174,225	126,150	5.3	2,523	57	79	79	53
Kentucky	21	30	28	74,538	109,440	93,600	5.0	3,089	86	86	78	59
Tennessee	21	27	25	68,982	88,298	91,120	3.7	2,734	91	84	80	65
Alabama	17	17	16	56,121	54,180	54,000	1.8	1,626	100	99	91	84
Mississippi	20	18	18	64,600	56,840	54,150	1.4	812	99	85	82	77
Louisiana	22	18	19	42,482	32,490	33,300	4.0	666	92	82	83	69
Texas	24	21	20	169,944	153,300	69,350	2.3	416	99	82	84	63
Oklahoma	11	19	22	56,936	101,878	36,888	1.6	369	90	75	74	50
Arkansas	19	20	20	47,500	50,490	49,712	3.5	1,044	96	80	79	69
Montana	32	26	25	976	612	530	3.0	3	106	65	......	112
Wyoming	29	23	24	522	368	196	.5	2	102	70	65	74
Colorado	15	21	22	6,300	8,736	5,222	3.5	52	98	75	76	75
New Mexico	19	22	26	1,610	2,083	2,322	1.5	28	98	110	69	90
Arizona	28	33	30	476	528	495	2.5	5	101	100	120	97
Utah	34	30	30	306	270	280	2.5	1	106	63	74	107
Nevada	34	30	33	34	30	30	1.0	....	106	......	......	......
Idaho	32	33	30	384	394	330	.4	1	102	75	70	80
Washington	28	27	26	952	846	855	1.8	4	105	85	76	80
Oregon	29	32	28	598	630	570	1.5	7	103	68	73	76
California	33	37	34	1,485	1,924	1,836	1.5	18	96	86	86	90
United States	23	29	27	2,463,017	3,124,746	2,531,488	4.4	64,764	95.8	75.3	70.7	58.4

Potatoes: Estimates based upon returns to Nov. 1, with details by States.

States.	Potatoes.								Sweet potatoes.						
	Yield per acre.		Production (000 omitted).		Quality (per cent of average).	Price.			Yield per acre.		Production (000 omitted).		Quality (per cent of average).	Price.	
	1913	10-year average.	1913	1912		Nov. 1, 1913.	Nov. 1, 1912.	Nov. 1, 1911.	1913	10-year average.	1913	1912		Oct. 15, 1913.	Oct. 15, 1912.
	Bu.	*Bu.*	*Bu.*	*Bu.*		*Cts.*	*Cts.*	*Cts.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*		*Cts.*	*Cts.*
Maine	220	199	26,840	23,166	102	50	41	68	....	....	....	....	....	....	....
New Hampshire	120	123	2,040	2,380	100	79	61	75	....	....	....	....	....	....	....
Vermont	127	119	3,175	3,640	108	67	50	68	....	....	....	....	....	....	....
Massachusetts	105	111	2,730	3,380	105	80	63	82	....	....	....	....	....	....	....
Rhode Island	125	124	625	565	103	90	77	100	....	....	....	....	....	....	....
Connecticut	92	100	2,208	2,461	99	82	72	96	....	....	....	....	....	....	....
New York	74	94	27,454	38,160	100	77	47	74	....	....	....	....	....	....	....
New Jersey	95	100	8,930	9,936	97	76	58	102	138	119	3,174	2,760	103	63	90
Pennsylvania	88	87	23,320	28,885	106	80	51	85	110	101	110	120	101	102	97
Delaware	87	90	957	1,100	102	70	65	130	135	116	675	600	104	44	65
Maryland	87	86	3,480	4,144	98	69	53	91	141	114	1,128	1,000	103	50	70
Virginia	94	82	9,400	8,265	101	68	68	96	108	96	3,564	2,970	102	70	72
West Virginia	82	88	3,936	5,264	93	95	66	108	91	95	182	230	100	95	90
North Carolina	79	76	2,370	2,550	101	77	68	105	100	94	7,400	6,750	101	63	70
South Carolina	80	82	800	900	103	126	119	122	92	85	4,508	5,040	100	75	70
Georgia	82	76	984	936	100	116	96	119	87	85	7,221	7,290	99	76	75
Florida	76	88	912	1,023	103	122	126	150	110	111	2,310	2,352	100	80	81
Ohio	67	87	12,462	20,832	93	88	53	79	90	101	90	118	100	110	100
Indiana	53	83	4,558	9,918	85	85	45	76	78	98	78	116	94	100	80
Illinois	46	83	6,256	13,837	79	84	57	79	70	101	560	784	94	105	97
Michigan	96	93	33,600	36,750	102	55	35	52	....	....	....	....	....	....	....
Wisconsin	109	95	32,046	34,920	107	56	31	48	....	....	....	....	....	....	....
Minnesota	110	94	26,730	33,075	107	49	26	49	....	....	....	....	....	....	....
Iowa	48	88	8,256	18,966	84	82	39	63	80	90	160	180	98	103	105
Missouri	39	77	3,666	7,980	73	94	68	98	56	96	280	528	83	115	100
North Dakota	85	96	4,080	6,656	102	52	25	52	....	....	....	....	....	....	....
South Dakota	78	86	4,602	6,510	99	62	34	62	....	....	....	....	....	....	....
Nebraska	48	78	5,664	9,440	89	74	49	87	....	92	....	....	....	....	....
Kansas	40	68	2,800	5,740	86	90	69	104	50	100	250	495	82	150	110
Kentucky	49	79	2,450	5,151	81	94	67	113	75	86	675	810	93	95	80
Tennessee	64	75	2,432	3,344	89	98	67	107	80	85	1,520	1,800	93	94	77
Alabama	84	78	1,260	1,215	98	107	98	122	95	84	5,985	6,200	99	76	77
Mississippi	82	88	820	890	100	104	91	117	98	90	5,194	5,044	100	72	74
Louisiana	70	67	1,470	1,460	94	110	75	113	85	87	4,930	4,704	92	70	72
Texas	52	64	2,704	3,276	94	112	105	138	80	79	2,960	2,700	100	110	120
Oklahoma	60	66	1,800	1,740	98	104	98	124	64	95	256	368	93	110	100
Arkansas	72	72	1,872	1,750	95	98	96	119	90	85	1,530	1,584	101	94	97
Montana	140	149	5,040	6,105	99	56	38	70	....	....	....	....	....	....	....
Wyoming	140	141	1,540	1,540	104	79	58	142	....	....	....	....	....	....	....
Colorado	115	125	9,315	8,075	96	61	50	80	....	....	....	....	....	....	....
New Mexico	68	86	544	900	91	110	114	100	....	151	....	....	....	....	154
Arizona	75	120	75	125	96	160	133	170	....	153	....	....	....	165	196
Utah	180	152	3,240	3,515	103	57	40	74	....	....	....	....	....	....	....
Nevada	160	153	1,760	2,136	103	75	69	83	....	....	....	....	....	....	....
Idaho	170	160	5,440	6,475	99	49	34	65	....	....	....	....	....	....	....
Washington	123	143	7,257	11,356	99	58	35	72	....	....	....	....	....	....	....
Oregon	135	118	7,290	10,075	103	52	36	64	....	....	....	....	....	....	....
California	115	133	7,360	10,140	92	68	63	85	170	135	1,020	936	99	125	90
United States.	89	96	328,550	420,647	99	69.6	45.5	76.3	95.0	91.0	55,760	55,479	99	78.0	79.0

Buckwheat and flaxseed: Estimates based upon returns to Nov. 1, with details by States.

States.	Buckwheat.							Flaxseed.						
	Yield per acre.		Production (000 omitted).		Quality (per cent of average).	Price.		Yield per acre.		Production (000 omitted).		Quality (per cent of average).	Price.	
	1913	10-year average.	1913	1912		Nov. 1, 1913.	Nov. 1, 1912.	1913	10-year average.	1913	1912		Nov. 1, 1913.	Nov. 1, 1912.
	Bu.	*Bu.*	*Bu.*	*Bu.*		*Cts.*	*Cts.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*		*Cts.*	*Cts.*
Maine	31	30	403	412	100	77	75							
New Hampshire	32	24	32	31	90		75							
Vermont	25	24	196	240	93	87	100							
Massachusetts	17	19	34	42	80	100								
Rhode Island														
Connecticut	17	18	51	62	82	100	100							
New York	14	21	4,004	6,593	90	80	62							
New Jersey	22	20	264	264	98	71	71							
Pennsylvania	19	20	5,716	7,405	98	71	63							
Delaware	17	20	68	64	98		75							
Maryland	17	18	198	210	90	75	70							
Virginia	23	18	531	516	99	81	84							
West Virginia	21	20	738	888	100	78	69							
North Carolina	19	16	174	175	100	82	92							
South Carolina														
Georgia														
Florida														
Ohio	19	19	352	410	94	77	65							
Indiana	19	17	74	95	91	85	86							
Illinois	17	18	68	88	93	92	110							
Michigan	15	15	960	1,088	101	68	62							
Wisconsin	17	16	297	289	103	71	72	14.0	13.1	126	125	97	118	
Minnesota	17	16	99	126	103	61	60	9.3	10.0	3,311	4,121	99	123	136
Iowa	14	15	98	133	99	83	80	9.4	10.7	329	402	101	117	142
Missouri	11	16	22	30	99	92	100	5.0	7.0	50	72	94	102	
North Dakota								7.4	8.7	7,563	12,086	101	120	132
South Dakota								7.2	9.1	3,564	5,323	99	118	133
Nebraska	21	17	21	18	101			7.5	8.9	15	19	94	110	130
Kansas	10	15	10	16	87			6.0	6.9	276	300	97	112	153
Kentucky														
Tennessee	15	16	45	54	102	75	71							
Alabama														
Mississippi														
Louisiana														
Texas														
Oklahoma								7.0	9.8	7	9	105		
Arkansas														
Montana								9.0	10.7	3,933	5,520	106	114	
Wyoming														
Colorado								5.0	7.3	60	96			
New Mexico														
Arizona														
Utah														
Nevada														
Idaho														
Washington														
Oregon														
California														
United States	17	20	14,455	19,249	95.5	75.5	65.5	7.9	9.0	19,234	28,073	101.8	118.7	133.4

Tobacco crop and weights of grain: Estimates based upon returns to Nov. 1, with details by States.

States.	Tobacco.					Grain, weight per bushel.					
	Yield per acre.		Production (000 omitted.)		Quality.	Wheat.		Oats.		Barley.	
	1913	10-year average	1913	1912	Per cent of average	1913	10-year average	1913	10-year average	1913	3-year average
	Lbs.	*Lbs.*	*Pounds.*	*Pounds.*		*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Maine	......	......	......	......	......	60.5	60	34.3	33	49	49
New Hampshire	1,650	1,696	165	170	102	......	......	32.0	32	48	47
Vermont	1,550	1,687	155	170	98	59.0	57	32.7	31	48	46
Massachusetts	1,550	1,654	9,455	9,860	98	......	......	32.5	31	......	......
Rhode Island	......	......	......	......	......			30.0	31	......	......
Connecticut	1,550	1,664	28,520	29,750	95	......	......	30.7	30	......	......
New York	1,020	1,205	4,386	5,200	85	59.5	59	32.4	32	48	47
New Jersey	......	......	......	......	......	59.0	59	30.0	29	......	......
Pennsylvania	1,200	1,333	46,680	64,090	91	59.7	59	32.0	31	48	47
Delaware	......	......	......	......	......	58.5	59	30.0	29	......	......
Maryland	740	668	18,500	17,160	97	59.5	59	31.0	30	48	45
Virginia	770	735	151,228	112,200	102	59.5	59	31.2	31	48	46
West Virginia	680	742	10,200	12,008	100	59.0	59	31.2	31	......	......
North Carolina	670	632	135,541	110,980	106	59.5	59	31.9	31	......	......
South Carolina	760	742	33,288	24,500	109	59.5	59	32.0	31	......	......
Georgia	1,000	744	1,800	1,162	105	58.8	58	31.8	31	......	......
Florida	1,000	808	4,000	2,604	99	......	......	28.5	30	......	......
Ohio	750	875	61,425	79,304	100	59.0	58	31.0	31	47	46
Indiana	750	839	11,925	14,960	97	58.5	58	28.5	30	48	46
Illinois	700	765	560	684	96	59.0	58	29.0	30	45	47
Michigan	......	......	......	......	......	58.8	58	32.0	31	48	46
Wisconsin	1,180	1,228	50,740	54,438	96	58.9	57	33.2	31	47	46
Minnesota	......	......	......	......	......	57.0	55	33.0	31	46	46
Iowa	......	......	......	......	......	58.3	57	32.0	31	46	47
Missouri	650	827	3,315	6,000	86	59.2	58	28.8	30	......	......
North Dakota	......	......	......	......	......	58.0	56	34.6	33	45	45
South Dakota	......	......	......	......	......	58.0	56	33.2	32	45	45
Nebraska	......	......	......	......	......	59.6	58	32.0	31	46	45
Kansas	......	......	......	......	......	58.1	58	29.7	31	44	43
Kentucky	760	833	271,472	343,980	93	59.0	58	30.9	31	48	46
Tennessee	720	754	59,400	72,600	94	59.0	58	30.7	31	......	......
Alabama	700	519	210	225	105	58.5	58	31.5	31	......	......
Mississippi	......	......	......	......	......	58.3	58	31.5	31	......	......
Louisiana	450	484	270	150	115	......	......	33.0	31	......	......
Texas	600	640	120	140	100	58.0	57	31.0	30	47	46
Oklahoma	......	......	......	......	......	57.0	58	30.0	30	43	47
Arkansas	650	629	520	520	106	58.5	58	31.7	31	......	......
Montana	......	......	......	......	......	60.1	60	38.0	38	50	52
Wyoming	......	......	......	......	......	60.2	59	38.8	38	51	50
Colorado	......	......	......	......	......	59.4	59	36.2	37	48	50
New Mexico	......	......	......	......	......	59.5	60	34.5	34	51	51
Arizona	......	......	......	......	......	61.0	60	36.0	36	48	50
Utah	......	......	......	......	......	61.6	60	37.5	37	50	49
Nevada	......	......	......	......	......	60.3	60	38.0	37	49	46
Idaho	......	......	......	......	......	59.9	60	37.0	37	49	49
Washington	......	......	......	......	......	59.0	59	34.5	36	48	47
Oregon	......	......	......	......	......	60.1	60	37.6	36	49	46
California	......	......	......	......	......	58.0	58	33.0	34	47	47
United States	790	824	903,875	962,855	97	58.7	57.8	32.1	31.5	46.5	46.

Fruits: Estimates based upon returns to Nov. 1, with details by States.

States.	Apples.							Pears.		Grapes.		Cranberries.		Sugar beets.	
	Production.[1]			Quality.		Price.		Production.[1]		Production.[1]		Production.[1]		Condition.	
	1913	1912	10-year average.	1913	1912	Oct. 15, 1913.	Oct. 15, 1912	1913	10-year average.	1913	10-year average.	1913	7-year average.	1913	7-year average.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Me.	39	72	64	85	87	96	60	65	72	......	......	70	76	......	......
N. H.	35	85	62	75	91	105	65	......	......	......	......	90	73	......	......
Vt.	20	73	65	72	88	100	65	......	......	......	......	......	......	......	......
Mass.	50	69	58	83	88	125	75	92	70	80	74	76	75	......	......
R. I.	70	58	57	84	84	100	99	97	71	90	76	88	73	......	......
Conn.	70	57	57	85	85	79	73	96	68	82	69	75	78	......	......
N. Y.	33	75	57	73	85	89	50	84	67	58	79	100	83	......	......
N. J.	56	47	56	80	76	78	63	57	65	73	83	59	73	......	......
Pa.	39	49	59	76	80	80	60	60	64	55	77	......	......	......	......
Del.	33	80	61	78	88	90	68	22	63	68	79	......	......	......	......
Md.	35	70	64	82	88	75	60	32	67	55	77	......	......	......	......
Va.	30	88	53	70	87	73	50	22	57	60	74	......	......	......	......
W. Va.	9	89	53	67	90	110	50	12	51	41	68	......	......	......	......
N. C.	30	78	56	65	80	86	73	25	58	73	77	......	......	......	......
S. C.	27	64	56	60	76	125	100	32	64	78	76	......	......	......	......
Ga.	40	60	52	70	77	102	95	42	61	80	77	......	......	......	......
Fla.	......	......	......	......	......	......	......	35	58	......	......	......	......	......	......
Ohio.	24	53	44	67	86	100	60	50	60	50	76	......	......	84	88
Ind.	59	38	43	72	71	65	65	73	60	77	76	90	78	84	......
Ill.	62	44	38	68	74	65	68	64	50	82	74	......	......	82	88
Mich.	42	82	55	74	85	60	43	69	66	63	76	80	70	91	90
Wis.	90	48	58	87	81	68	80	85	64	92	76	78	78	85	88
Minn.	108	44	66	95	85	70	100	......	......	88	75	......	......	89	88
Iowa.	68	16	50	76	73	80	92	85	50	88	73	......	......	87	......
Mo.	34	83	44	56	76	73	45	46	44	69	68	......	......	......	......
N. Dak.	98	......	......	97	......	90	......	......	......	......	......	......	......	......	......
S. Dak.	87	61	69	87	80	115	100	90	......	76	75	......	......	......	......
Nebr.	48	60	54	67	80	90	78	60	49	73	67	......	......	80	90
Kans.	30	75	46	56	77	100	57	38	51	46	60	......	......	60	84
Ky.	50	70	46	65	79	75	60	40	52	90	76	......	......	......	......
Tenn.	37	83	47	64	84	99	63	35	46	78	68	......	......	......	......
Ala.	42	58	51	63	75	100	75	45	57	74	71	......	......	......	......
Miss.	48	59	49	63	78	100	86	53	57	75	65	......	......	......	......
La.	50	68	50	70	75	95	100	68	60	......	......	......	......	......	......
Tex.	45	72	56	72	79	124	105	48	63	73	72	......	......	......	......
Okla.	45	75	57	66	79	110	88	36	58	62	66	......	......	......	......
Ark.	50	75	49	65	70	85	80	38	51	84	63	......	......	......	......
Mont.	82	90	84	90	95	120	75	75	83	......	......	......	......	95	98
Wyo.	93	120	90	99	103	138	......	......	......	......	......	......	......	95	97
Colo.	70	70	65	85	82	100	97	62	66	72	77	......	......	90	91
N. Mex.	73	89	66	85	87	115	105	71	68	80	70	......	......	......	......
Ariz.	72	110	75	85	100	190	196	82	78	90	83	......	......	90	......
Utah.	82	100	78	88	91	74	91	70	73	95	87	......	......	96	97
Nev.	72	120	71	90	97	165	115	......	......	......	......	......	......	97	......
Idaho.	79	100	79	87	96	105	85	82	76	87	86	......	......	98	90
Wash.	70	100	78	87	94	90	65	80	83	91	88	......	......	94	90
Oreg.	82	100	76	88	96	80	59	81	80	90	88	......	......	95	92
Cal.	47	90	78	80	91	100	75	72	76	79	87	......	......	87	92
U.S.	45	70	52	70	83	86	61	59	64	73	81	70	75	89	91

[1] Production estimates expressed in percentages of a full crop.

Miscellaneous crops: Estimates based upon returns to Nov. 1, with comparisons by States.

States.	Clover seed.				Kafir corn.		Peanuts.		Cowpeas.				Sorghum.	
	Production.[1]		Price.		Production of grain.[1]		Production.[1]		Production of grain.[1]		Production of forage.[1]		Yield of sirup.	
	1913	1912	Oct. 15, 1913.	Oct. 15, 1912.	1913	1912	1913	1912	1913	1912	1913	1912	1913	10-year average.
	P. ct.	*P. ct.*	*Dolls.*	*Dolls.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Galls.*	*Galls.*
Me.														
N. H.														
Vt.														
Mass.														
R. I.														
Conn.														
N. Y.	85	90	9.93	10.97					65	85	74	90		
N. J.	82	90							75	90	87	88		
Pa.	62	81	7.23	9.50					75	80	80	89		
Del.	58	92							78	70	84	72		
Md.	61	90							74	84	82	84		
Va.	77	90	9.00	11.03			84	67	76	65	83	67	94	95
W. Va.	67	93	10.00	9.00					81	88	85	94	87	101
N. C.	85	85	8.90	10.67			83	83	68	65	80	69	93	88
S. C.							85	85	69	73	83	80	92	85
Ga.	80	71					86	84	77	75	84	82	106	89
Fla.							91	88	79	81	86	84	160	150
Ohio.	84	65	6.47	10.00					80	80	85	90	78	90
Ind.	80	73	6.49	8.98					66	84	73	86	89	98
Ill.	70	69	7.20	8.98					60	79	69	83	75	91
Mich.	92	73	6.90	9.90					80	80	70	75		
Wis.	92	88	6.90	8.76	85	95			81	80	95	86	80	100
Minn.	84	82	8.00	9.70					81		78		95	90
Iowa.	89	76	6.90	9.49					88		75		90	96
Mo.	66	69	8.30	9.13	44	84			33	68	50	76	63	95
N. Dak.	91	96							95		100			
S. Dak.	90	81											60	
Nebr.	84	70	8.70	9.83	45	85			50	75	50	81	35	81
Kans.	72	64	8.00	8.62	22	85			35	70	44	72	50	83
Ky.	75	74	8.00	9.97					64	81	73	90	86	91
Tenn.	78	82	9.00	10.67			74	90	60	78	69	85	82	92
Ala.	81	80					84	89	70	72	74	78	90	87
Miss.	89	90					82	84	68	76	74	80	92	84
La.							82	82	50	84	54	80	100	104
Tex.					81	85	78	82	65	75	72	80	85	84
Okla.	72	95			40	300	63	117	39	80	53	100	56	81
Ark.	88	88			76	85	75	81	50	73	62	70	84	88
Mont.	75	100							120		90			
Wyo.									95		95			
Colo.	90	99			75	100			100	95	98	95		106
N. Mex.					70	105	80	90	60	80	80	80		107
Ariz.					125	110	102	100	100	100	100	95	90	118
Utah.	90								93		95		119	126
Nev.														
Idaho.	101	100	7.00						83	98	94	98		
Wash.	95	98							86	90	90	93		
Oreg.	96	101	5.90	8.90					93	93	90	96		
Cal.	90	95			83	91	98	95	95	95	92	99		
U. S.	80	74	7.00	9.37	53	156	84	82					80	80

[1] Production estimates expressed in percentage of a full crop.

LEON M. ESTABROOK,
Chief Bureau of Statistics.

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U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

564

Contribution from the Bureau of Entomology, L. O. Howard, Chief.
January 29, 1914.

TY OF GENERAL LIBRARY * 1819 *

THE GIPSY MOTH AND THE BROWN-TAIL MOTH, WITH SUGGESTIONS FOR THEIR CONTROL.

By A. F. Burgess,
In Charge of Gipsy Moth and Brown-tail Moth Investigations.

INTRODUCTION.

In 1869 a number of egg clusters of the gipsy moth (*Porthetria dispar* L.), a destructive insect pest in Europe, were brought from France to Medford, Mass., by a naturalist who was carrying on experimental work with insects. Later in the season some of the caterpillars escaped, and although none was found in the vicinity during the next few years, enough specimens survived to enable the species to establish itself. In the summer of 1889 this insect became so abundant that fruit and shade trees in the neighborhood were completely defoliated, and the caterpillars swarmed over the trees and into the houses and became a serious nuisance. This resulted in the loss of valuable trees and in the depreciation of property values in that section.

For about 10 years effective work against the gipsy moth was carried on by the State of Massachusetts, and during this period the insect was kept under control. The work was discontinued in 1900, but the species had become so abundant and had caused such widespread injury by 1905 that systematic work was renewed by the State in order to protect the tree growth in the infested area. This work has been continued up to the present time, and as the insect has spread to other New England States it has become necessary to institute more extensive control measures.

In 1906, after the gipsy moth had become established in New Hampshire and Rhode Island, as well as in Massachusetts, an appropriation was made by Congress for suppressing it, and the Secretary of Agriculture was authorized to take all possible measures to prevent its spread. Since that time work has been carried on each year. The area now known to be infested is shown on the accompanying map (fig. 1).

The brown-tail moth (*Euproctis chrysorrhœa* L.) was first found in the United States in Somerville, Mass., during the summer of 1897 and was undoubtedly introduced some seasons previous to that time on imported nursery stock. The work of preventing damage by this insect was undertaken by the State of Massachusetts soon after the pest was discovered. This species occurs in many sections of Europe and is often seriously injurious. It spreads rapidly because the females are able to fly long distances. The accompanying map (fig. 1) shows the area in New England which is now infested by the brown-tail moth. Suppressive measures by the New England States and by the Federal Government have been directed against this insect as well as against the gipsy moth.

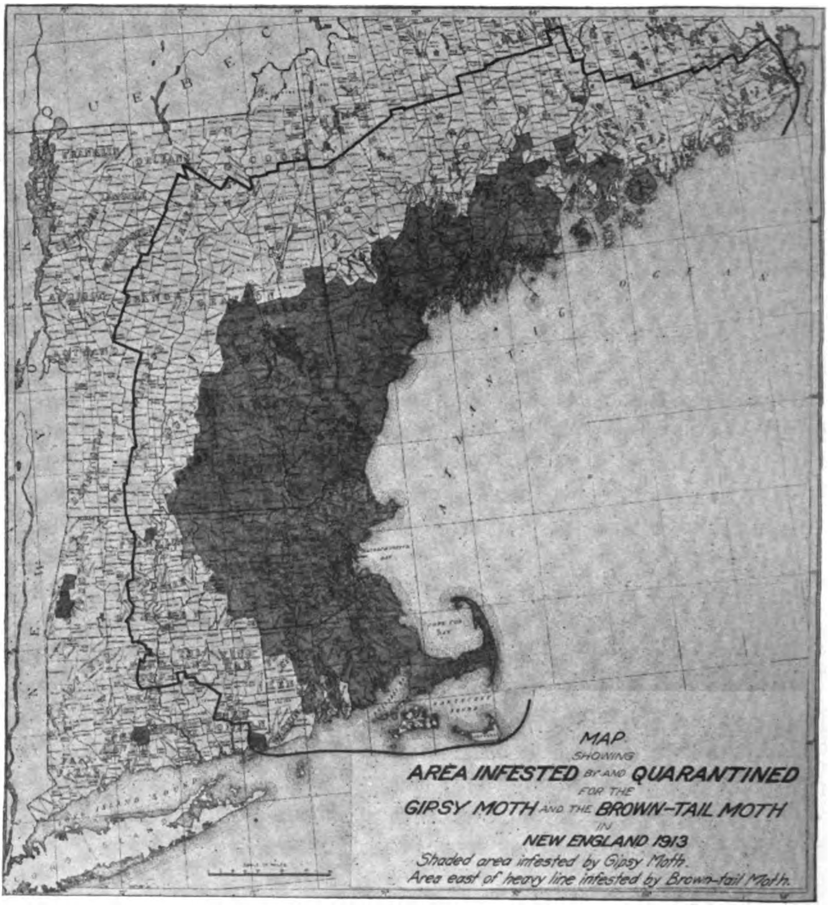
MAP
SHOWING
AREA INFESTED BY AND QUARANTINED
FOR THE
GIPSY MOTH AND THE BROWN-TAIL MOTH
IN
NEW ENGLAND 1913
Shaded area infested by Gipsy Moth.
Area east of heavy line infested by Brown-tail Moth.

Fig. 1.—Map showing area infested and quarantined for the gipsy moth and the brown-tail moth, 1913. (Original.)

It is the purpose of this bulletin to give a brief statement of the life history and habits of these two species and to suggest the best methods that can be adopted for their control.

The methods of protecting orchards and the street, park, and ornamental trees in cities and towns are set forth on the following pages, and these methods have been adopted as a result of many extensive experiments. A proper system of orchard management can be adopted which will enable the owner of infested trees to protect them fully without very much expense additional to that required for the control of the other injurious orchard insects. The expense of caring for infested city or park trees is somewhat greater than in the case of infested orchards, but practical methods can be adopted which will not render the cost prohibitive.

The control of these insects in forests is extremely difficult, owing to the small amount of money that any owner can afford to expend in preventing injury to his woodlands. This being so it is usually more satisfactory to have the woodland examined by an expert familiar with the insects and the best measures to be used for their control in order that suggestions for treatment may be made which will be applicable to the conditions in each particular case. Such information can usually be obtained from the State or local officials engaged in gipsy moth and brown-tail moth work, and so far as possible this office will cooperate with owners and give practical advice and suggestions as to the management of their infested premises.

THE GIPSY MOTH.

LIFE HISTORY.

(Fig. 2.)

The eggs.—The female gipsy moth deposits a cluster containing 400 eggs or more, which she covers with buff-colored hair. Most of the egg clusters are laid during the month of July and hatch about the time the leaves begin to appear the following spring. They are deposited on the underside of branches of trees, on tree trunks, under loose bark, or in cavities in the trunks or branches, and are sometimes placed on stones or rubbish and in a variety of situations where they are concealed from view. As the female moth does not fly, egg clusters are seldom found far from the food plant upon which the caterpillars developed.

The larvæ.—The newly-hatched larvæ feed on the opening leaves, making small perforations. They grow rapidly and become full fed early in July. During this period they molt five or six times, and as they increase in size a larger proportion of the foliage is eaten, so that if the infestation is severe, trees may be completely stripped of foliage before the end of June.

The pupæ.—When full grown the caterpillars shed their skin and transform to pupæ, which are chestnut brown in color and provided with tufts of yellow hairs. They remain in this dormant stage for about 10 days, after which the adult insects emerge.

The adults.—The male moth is dark brown in color, with black wing markings, and flies well. The female is white, with black markings on the wings, and does not fly on account of the weight of the abdomen. After mating the females begin depositing eggs.

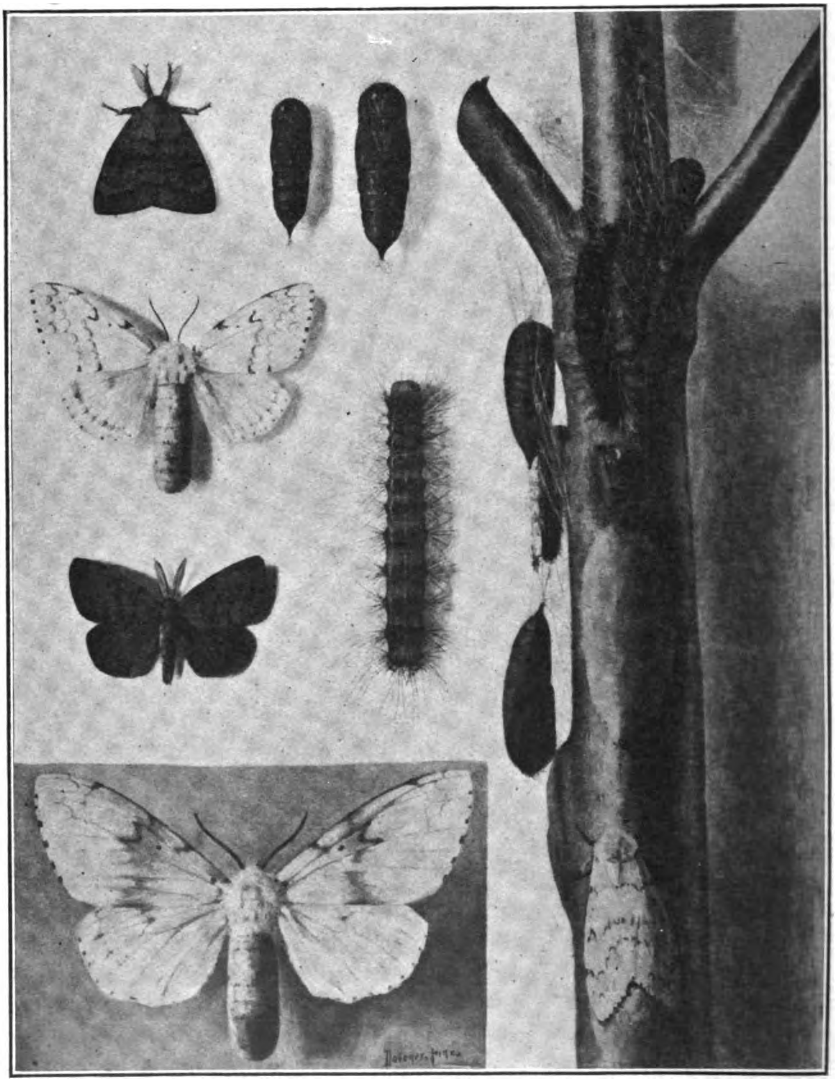

Fig. 2.—Different stages of the gipsy moth (*Porthetria dispar*): Egg mass on center of twig; female moth ovipositing just below; female moth below, at left, enlarged; male moth, somewhat reduced, immediately above; female moth immediately above, somewhat reduced; male moth with wings folded in upper left; male chrysalis at right of this; female chrysalis again at right; larva at center. (Original.)

FOOD PLANTS

The most favored food plants of the gipsy moth are the apple, the different species of oak, gray birch, alder, and willow. In cases of bad infestation nearly all of our deciduous trees are injured to a greater or less extent, with the exception of ash. Hickory is not a favored food plant, although the foliage occasionally shows severe feeding. Chestnut will not support the gipsy moth when the caterpillars are in the first stage, and pine will not support the first two stages; but if other food plants are present severe injury may result from feeding by the larger caterpillars. Beech is sometimes fed upon freely, and occasionally the trees are defoliated; and the same is true of poplar.

INJURY CAUSED BY THE GIPSY MOTH.

Unless reduced in numbers by natural enemies, or by the application of control measures, the gipsy moth is capable of causing enormous injury to tree growth. In the area in New England which has suffered most from this insect thousands of trees are dead as a result of defoliation. (See fig. 3.) Apple and oak have been injured most, but pine and other coniferous trees mixed with deciduous growth have suffered severely.

It is undoubtedly true that many oak trees which have been severely weakened as a result of defoliation by the gipsy moth and the brown-tail moth have failed to recover because of the attacks of certain wood-boring insects. The species which has caused the most damage in this way is *Agrilus bilineatus* Web., a beetle the larva of which feeds beneath the bark of injured trees.

NATURAL ENEMIES.

There are few insect enemies of the gipsy moth native to New England that cause any noticeable benefit in reducing its numbers. This is shown by the fact that between the years 1900 and 1905, when no systematic effort was made to suppress the insect, alarming injury resulted, and native insect enemies did not increase to any marked degree. The same is true of the work of native insectivorous birds. While they undoubtedly feed to some extent on gipsy-moth caterpillars, there is no case on record where they have been able to control the species. The wilt disease, which possibly may have occurred in this country for many years, has only recently become sufficiently abundant to be a prominent factor in natural control.

INTRODUCED PARASITES AND ENEMIES.

In 1905 an effort was made by the State of Massachusetts, in cooperation with the Bureau of Entomology, United States Department of Agriculture, to introduce the parasites and natural enemies of the gipsy moth from its native home in Europe and Japan. Since that time a large amount of parasitized material has been received nearly every year, and as a result some promising natural enemies have become established in this country and are assisting in bringing about the control of the species. The enemies which have become established and are at present destroying the largest number of gipsy-moth caterpillars and pupæ are a Calosoma beetle (*Calosoma sycophanta* L.); a tachinid fly (*Compsilura concinnata* Meig.), which is also a parasite of the brown-tail moth; and a species of Apanteles (*Apanteles lacteicolor* Vier.), which attacks small gipsy-moth and small

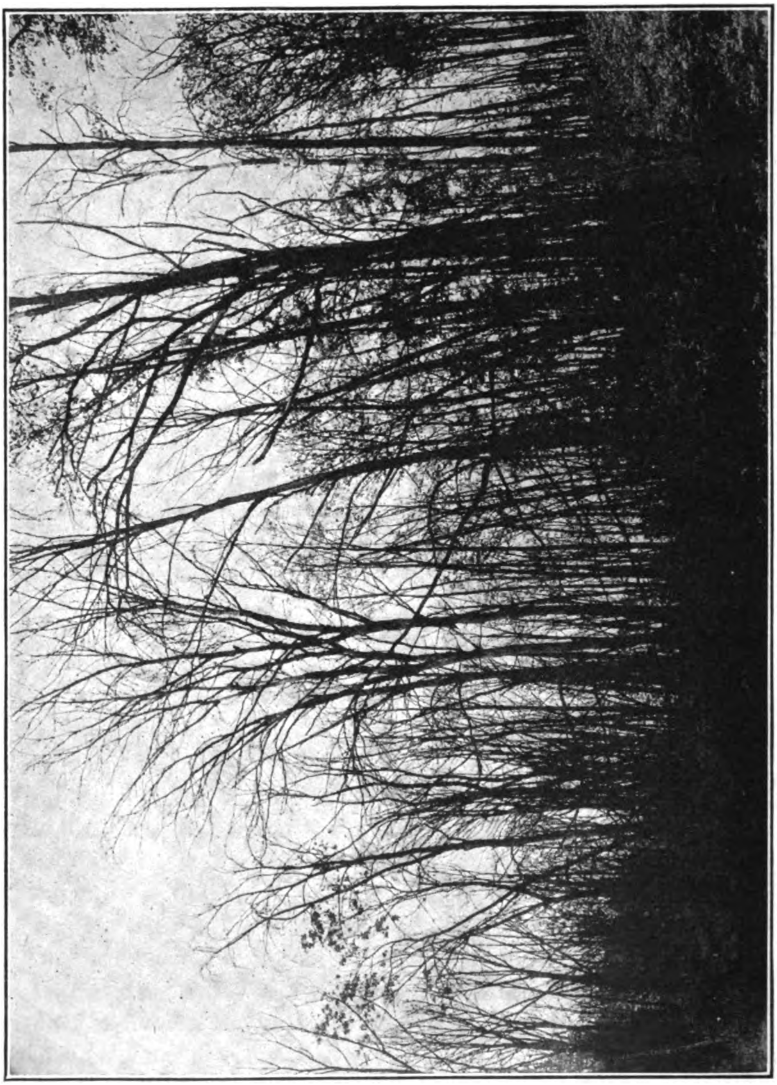

Fig. 3.—Dead and defoliated woodland resulting from gipsy moth attack. (Original.)

brown-tail moth caterpillars. Two species of egg parasites, namely, *Schedius kuvanæ* How., which was imported from Japan, and *Anastatus bifasciatus* Fonsc., which was secured from Europe, have also been colonized in a portion of the infested area and are valuable additions to the natural enemies of this insect.

During the past year the work of the natural enemies of the gipsy moth, including the imported parasites, the Calosoma beetle, and the wilt disease, has served greatly to reduce the numbers of the insect in many badly infested localities. This is particularly true in the region which has been infested longest, and it is hoped that when these enemies of the moth have become established in large numbers over the entire infested territory the insect will be much less a destructive factor than it is at present. Until such time as this can be brought about, however, the most effective hand or mechanical methods of fighting this pest should be continued.

THE BROWN-TAIL MOTH.

LIFE HISTORY.

(Fig. 4).

The eggs.—The female brown-tail moth deposits a small cluster of eggs on the underside of a leaf. These eggs are usually laid in July and are covered with brown hair taken from the body of the female. Hatching begins about the 15th of August.

The larvæ.—The newly hatched larvæ of this insect feed on the epidermis of the leaf and after molting once or twice begin to construct a winter web. This is made by drawing together several terminal leaves and securely fastening them by silk which is secreted by the caterpillars. The larvæ from one or more egg clusters live and feed in common, and as cold weather approaches they retire to the web, in which they remain during the winter. In the spring these larvæ leave the web as soon as the buds begin to develop and feed upon the bud scales and small leaflets. They become full-grown about the middle of June.

The pupæ.—After the caterpillars finish feeding they spin loose silken cocoons and pupate within them. These cocoons are sometimes constructed separately, but in many cases large numbers of them are spun in a single mass. About two weeks are spent in the pupal state.

The adults.—Emergence of the moth usually begins the first week in July. The adult brown-tail moth is pure white in color. The abdomen of the female is much larger than that of the male, but in both sexes the tip of the abdomen is covered with dark-brown hairs. These moths are attracted to strong light, such as electric arc lights, and as they fly at night it is often possible to secure many specimens around the arc lights in cities and towns during the first half of the month of July.

FOOD PLANTS.

The caterpillars of the brown-tail moth commonly feed on apple, pear, plum, oak, and willow, and they are sometimes found in considerable numbers on elm, maple, and rose and in smaller numbers on other common deciduous trees and shrubs. They never attack conifers and are seldom found on hickory, ash, chestnut, or birch.

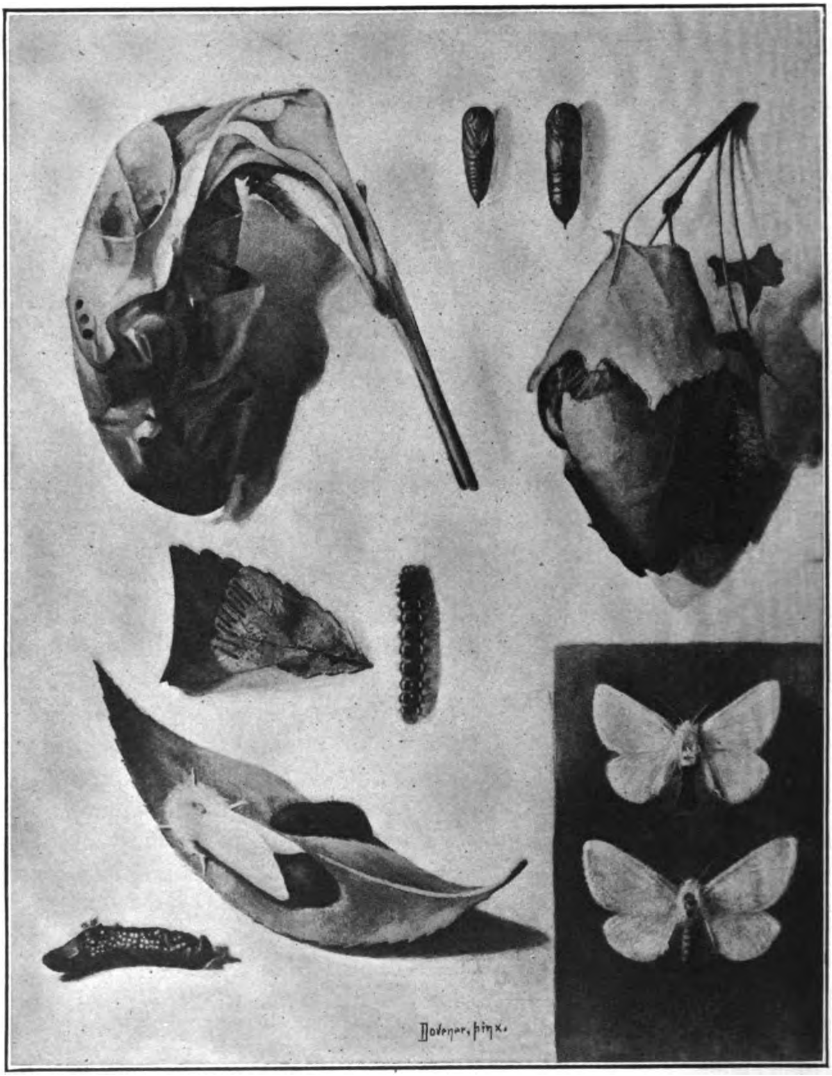
Dolener, pinx.

FIG. 4.—Different stages of the brown-tail moth (*Euproctis chrysorrhœa*): Winter nest at upper left; male and female adults, lower right; cocoon in leaves, upper right; male and female chrysalides above, male at left; full-grown larva in center, somewhat reduced; young larvæ at its left; egg mass removed from leaf, showing single eggs, at lower left; female ovipositing on leaf; egg mass also on same leaf. (Original.)

INJURY CAUSED BY THE BROWN-TAIL MOTH.

The principal injury caused by the brown-tail moth is due to the feeding habits of the larvæ in the spring. If the infestation is bad the caterpillars are often numerous enough to devour the leaves as fast as the trees are able to develop them. As the webs are made on the terminals, the growth of the trees is often severely checked. In severe infestations trees may be completely stripped (figs. 5, 6), but as the larvæ become full-grown during the first part of June, there is usually an opportunity for the trees to refoliate before midsummer. The young larvæ that hatch in August frequently skeletonize the leaves to a considerable extent. This does not damage the trees seriously, as the growing period for the season is nearly completed.

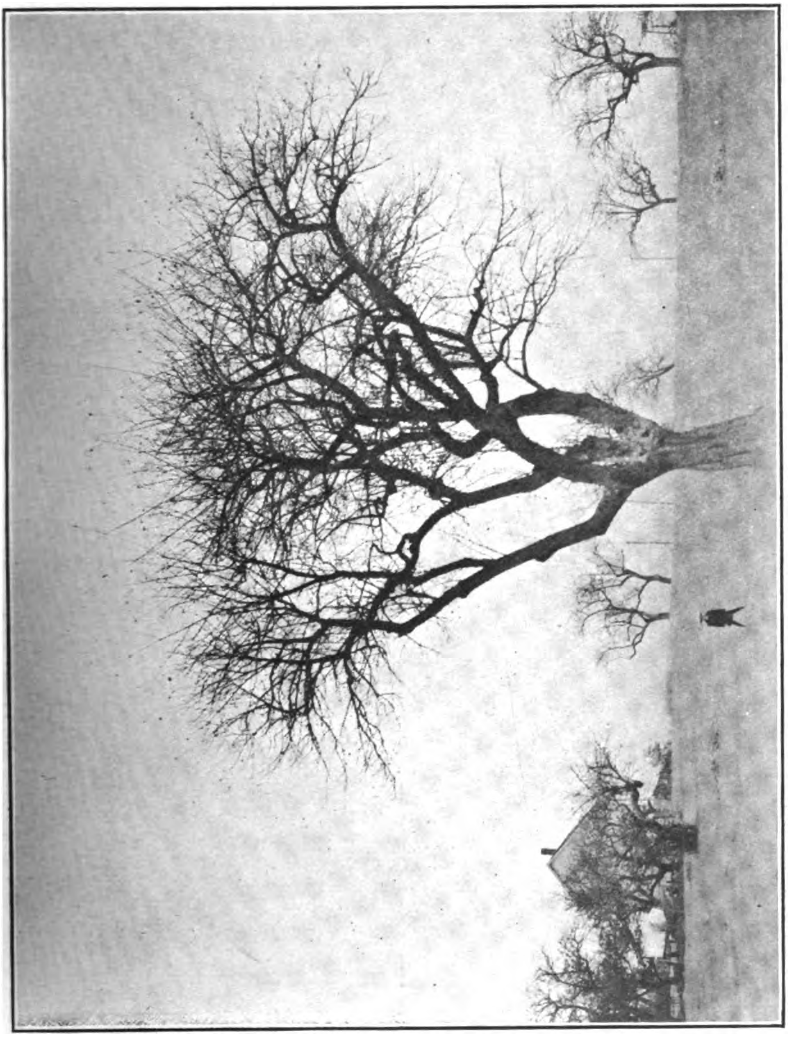

FIG. 5.—Apple trees stripped by brown-tail moth caterpillars. Note old winter webs at tops of trees. (Original.)

The bodies of the caterpillars of the brown-tail moth are provided with poisonous hairs. A microscopic examination of these hairs shows that the edges are barbed in such a way that when they come in contact with the human skin and are pressed into the flesh, intense irritation is caused. These hairs are also hollow and contain a poisonous substance which acts on the blood corpuscles. This causes

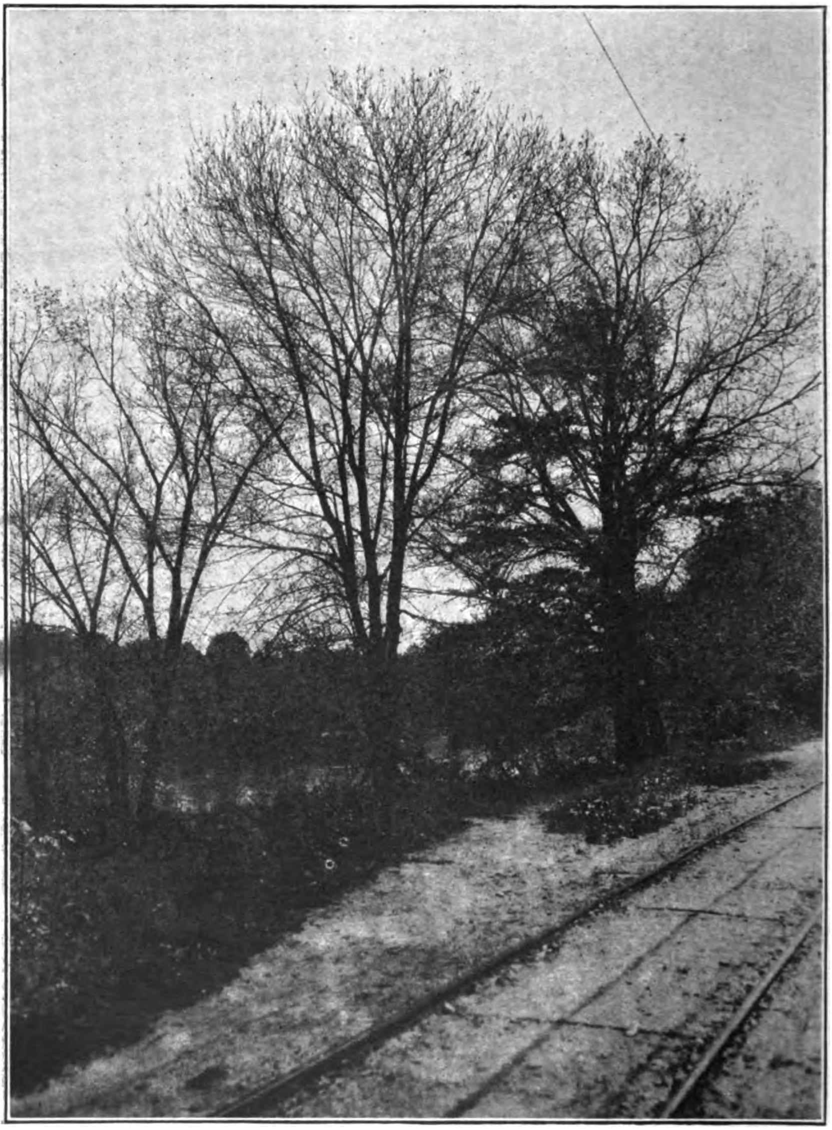

FIG. 6.—Red oak trees stripped by brown-tail moth caterpillers. Note old winter webs at tops of trees. (Original.)

serious poisoning and severe irritation accompanied with external swelling and is known as the brown-tail rash. There is considerable difference in the susceptibility of persons to this poison, but many cases are reported each year in the infested region, most of which are more serious than those of ivy poisoning. Many camps and summer cottages, particularly in wooded areas, can not be occupied with any comfort during the early summer on account of the poisoning resulting from these caterpillars. If clothing is hung on the line near badly infested trees the hairs frequently find lodgment and are brought into the houses, and later severe poisoning may result.

NATURAL ENEMIES.

One of the most important natural enemies of the brown-tail moth is a fungous disease, *Entomophthora aulicæ*, which attacks the caterpillars, particularly in the spring. It was first reported in this country by Dr. Roland Thaxter in 1888. Like all diseases of this nature, the benefit derived from it is regulated largely by favorable or unfavorable weather conditions. This fungus sometimes works to a slight degree on the small caterpillars in the fall, and in some instances it is found in the winter webs. As a rule, however, the greatest mortality of caterpillars takes place in the spring, when they are nearly full-grown, and the pupæ of the moth may, under the most favorable conditions, be almost completely exterminated. Native parasites and predaceous insects have done very little to check the increase of the brown-tail moth.

INTRODUCED PARASITES AND ENEMIES.

The parasites and enemies already mentioned as being particularly valuable for their work in destroying the gipsy moth also attack the brown-tail moth, with the exception of the egg parasites. The Calosoma beetle, *Calosoma sycophanta*, and its larvæ do valuable work each year in destroying brown-tail caterpillars and pupæ, and the dipterous and hymenopterous parasites also attack this species in considerable numbers. Another imported parasite, namely, *Meteorus versicolor* Wesm., has become established in this country and is doing good work. It attacks the brown-tail moth caterpillars, but not those of the gipsy moth.

In some parts of the infested territory where some of the first parasite liberations were made a marked decrease in the number of moths has been noted during the past two years. The work of the parasites will undoubtedly be more pronounced after they have become more abundant over the entire infested territory.

HAND METHODS FOR CONTROLLING THE BROWN-TAIL MOTH.

The brown-tail moth can be controlled by cutting off the winter webs and burning them before the caterpillars begin to emerge in April. These webs should be destroyed by fire, for if they are simply cut from the tree and left on the ground the caterpillars will emerge and no benefit will result from the work which has been done.

In orchard practice it is sometimes inadvisable to cut the winter webs, for where an infestation is bad it is likely to leave a poorly shaped tree. Spraying in the spring is not a satisfactory remedy unless the infestation is very light, because the caterpillars, when they occur in large numbers, do not allow the tree to put out sufficient foliage to hold the spray material. The most effective method is to spray the trees before the middle of August, using from 6 to 10 pounds of arsenate of lead to 100 gallons of water. Before spraying operations of this sort are attempted care should be taken to determine whether the trees are well infested with egg masses of the brown-tail moth, for if the infestation is very slight it will be more satisfactory to cut and destroy the webs. If the infestation warrants, both shade, ornamental, and fruit trees may be sprayed to advantage at this time. Caution should be used, however, in spraying fruit trees, particularly if early fall varieties are to be treated. If this is to be done a somewhat weaker spray solution may be used, provided it is applied as soon as the caterpillars begin to hatch. The foliage should be treated thoroughly, particularly the terminal shoots, and as much care as possible should be exercised not to cover the fruit. Late fall or winter varieties of fruit may be sprayed in August with arsenate of lead, using 6 pounds to 100 gallons of water, and although an occasional spot may be found on the fruit at the time of picking no injury will result from it. In cases where only a few choice fruit trees are to be sprayed it is practicable to wipe the fruit before packing for sale; but this is not necessary if care is taken to treat the terminal growth of the trees, as this is where the bulk of the egg clusters is deposited.

GENERAL HAND METHODS FOR CONTROLLING THE GIPSY MOTH.

Creosote.—One of the best methods of controlling the gipsy moth is to treat the egg clusters of the insect between August 1 and April 1 with creosote, to which a small amount of lampblack has been added. This mixture is applied with a brush, and it leaves a black residue on the clusters treated. Creosote may be obtained in small quantities from nearly all the large hardware or seed stores in the infested district, where it usually sells for about 35 cents a gallon. If secured in larger quantities a much lower price can be obtained.

Burlap bands.—Gipsy moth caterpillars usually seek shelter during hot, sunny days, and if a band of burlap is attached to a tree large numbers of them will crawl beneath it, where they may be crushed each day. Ordinarily a strip of burlap about 8 inches wide is placed loosely around a tree trunk and a piece of twine passed around the center and tied to hold it in place. After this is done the top part of the burlap is folded down so that a double shelter is made beneath it. The use of burlap bands has been discontinued to a great extent during the last few years, owing to the expense involved and because

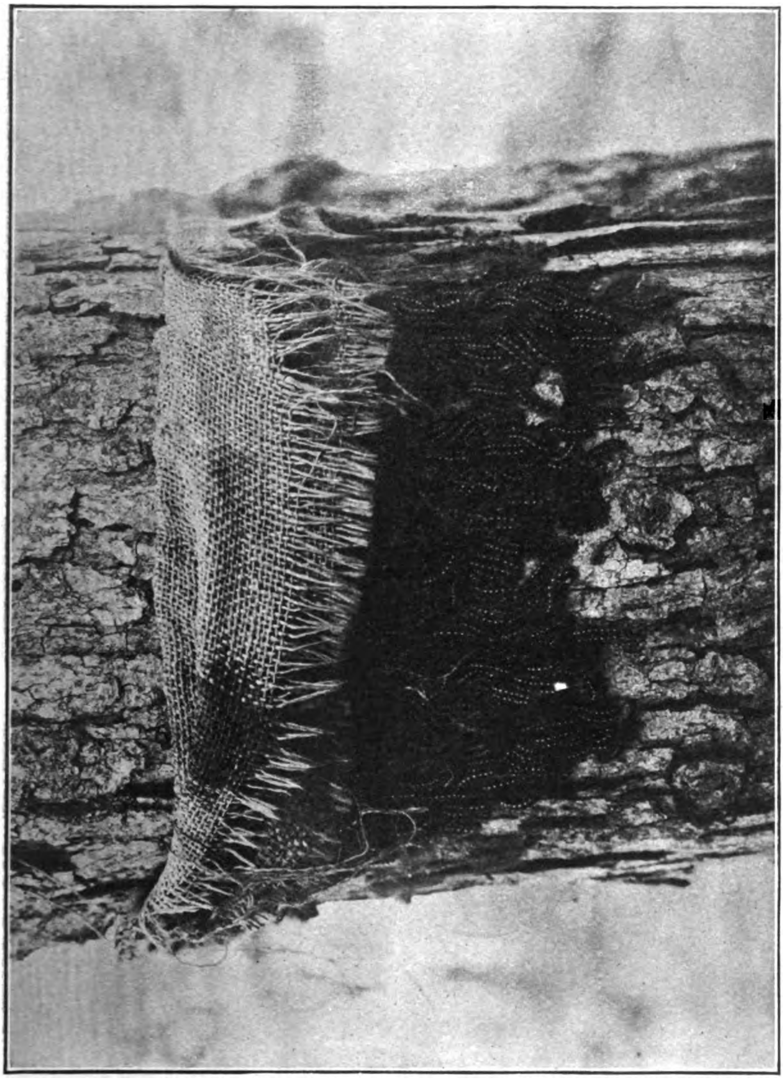

Fig. 7.—Burlap band on tree. The caterpillars beneath it are nearly all those of the brown-tail moth. (Original.)

of the fact that if the burlaps are applied early in the season, before the brown-tail caterpillars have pupated, an excellent place is furnished for these poisonous caterpillars to make their cocoons (see fig. 7), and severe poisoning results to the workmen. If this method

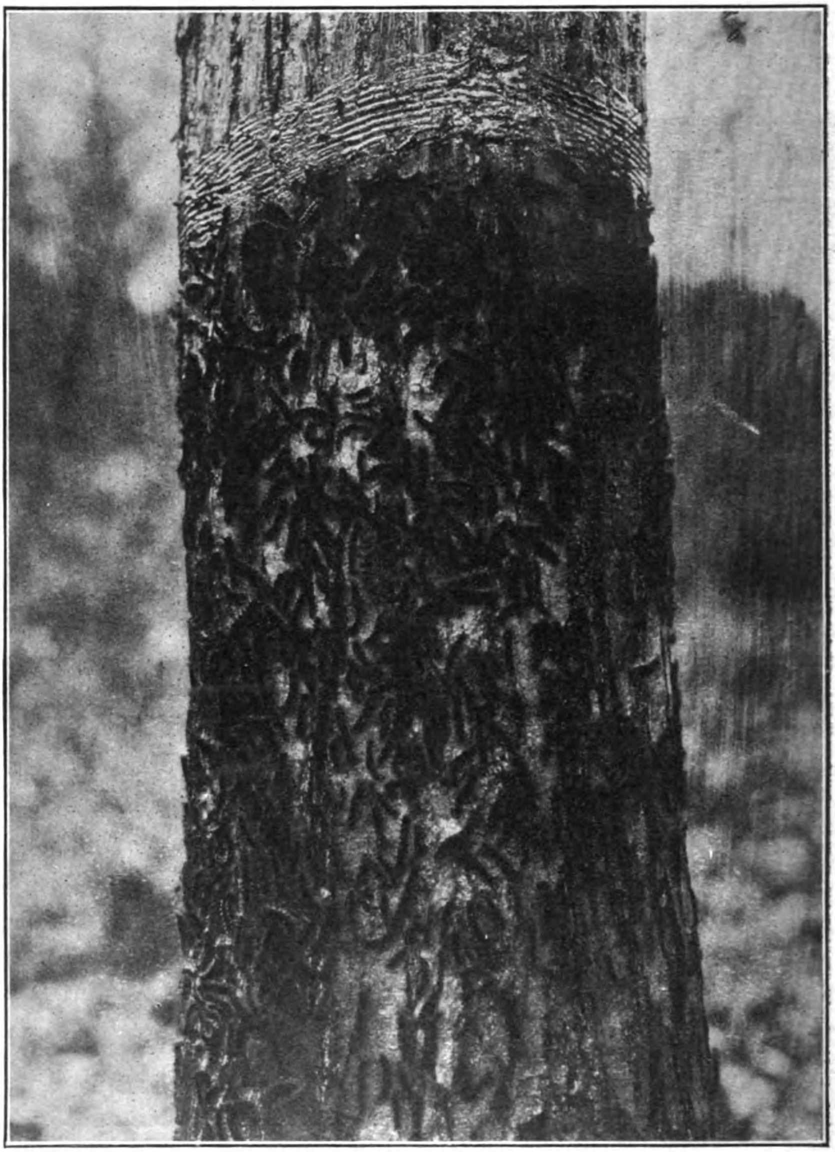

FIG. 8.—Tanglefoot band. Note that there are enormous numbers of gipsy moth caterpillars below the band and on the ground, but none above it. (Original.)

is to be used at all the burlap should not be attached to the trees until after June 15, when most of the brown-tail caterpillars will have pupated.

Tanglefoot bands.—A band of tanglefoot may be used on tree trunks after the bark has been scraped so that the sticky material can be applied evenly in a thin layer with a paddle. The purpose of this band is to prevent caterpillars from ascending the trees, and if the egg clusters have previously been treated this is a very effective measure. It is necessary every week or 10 days during the caterpillar season to run a comb or other similar implement around the band in order to prevent hardening of the surface and to bring up fresh, sticky material from the part of the band near the bark. (See fig. 8.) Placing these bands on the trees prevents the caterpillars from reaching the foliage; and as the latter usually mass in large numbers beneath the bands, conditions are favorable for wilt disease to develop, and the caterpillars often die in large numbers from this cause and from starvation.

Spraying.—The most effective spray for the gipsy moth is arsenate of lead paste applied to the foliage at the rate of 10 pounds to 100 gallons of water. It is necessary that the treatment be thorough and the application even, if best results are to be secured. For small operations the ordinary orchard sprayer may be used with one or more lines of hose equipped with nozzles of the Vermorel or Bordeaux type. In case large shade trees on valuable park or woodland are to be treated, however, the use of a high-power sprayer is more economical. The type that has given the most satisfactory results in the gipsy-moth work develops sufficient power to throw a solid stream of spray into the trees. The nozzle is constructed so that the stream will break into a fine mist high in the air, and this results in very satisfactory and rapid treatment. (See fig. 9.) With such a sprayer it is unnecessary to climb trees and use small lines of hose, which is a slow and expensive operation. A satisfactory high-power sprayer for this work should be equipped with a 10-horsepower gasoline engine and a triplex pump capable of delivering 35 gallons of liquid per minute at a pressure of from 200 to 250 pounds. This machinery, together with a 400-gallon tank, should be mounted on well-built trucks. One-inch hose is used, and with the outfit mentioned the spray material can be conducted through several hundred feet of this hose without seriously reducing the nozzle pressure, which should be maintained at about 230 pounds.

HAND METHODS TO BE USED AGAINST THE GIPSY MOTH IN ORCHARDS.

The methods to be used for controlling the gipsy moth in orchards should be based largely on the severity of the infestation. If only a few egg clusters are present in the orchard, early spraying, such as is applied for the codling moth after the blossoms fall, will be found useful, providing the amount of poison used is increased to 10 pounds to 100 gallons of water. If the infestation is more serious, a second spraying early in June, using a similar amount of poison, will be found very satisfactory. In cases where the infestation is severe it

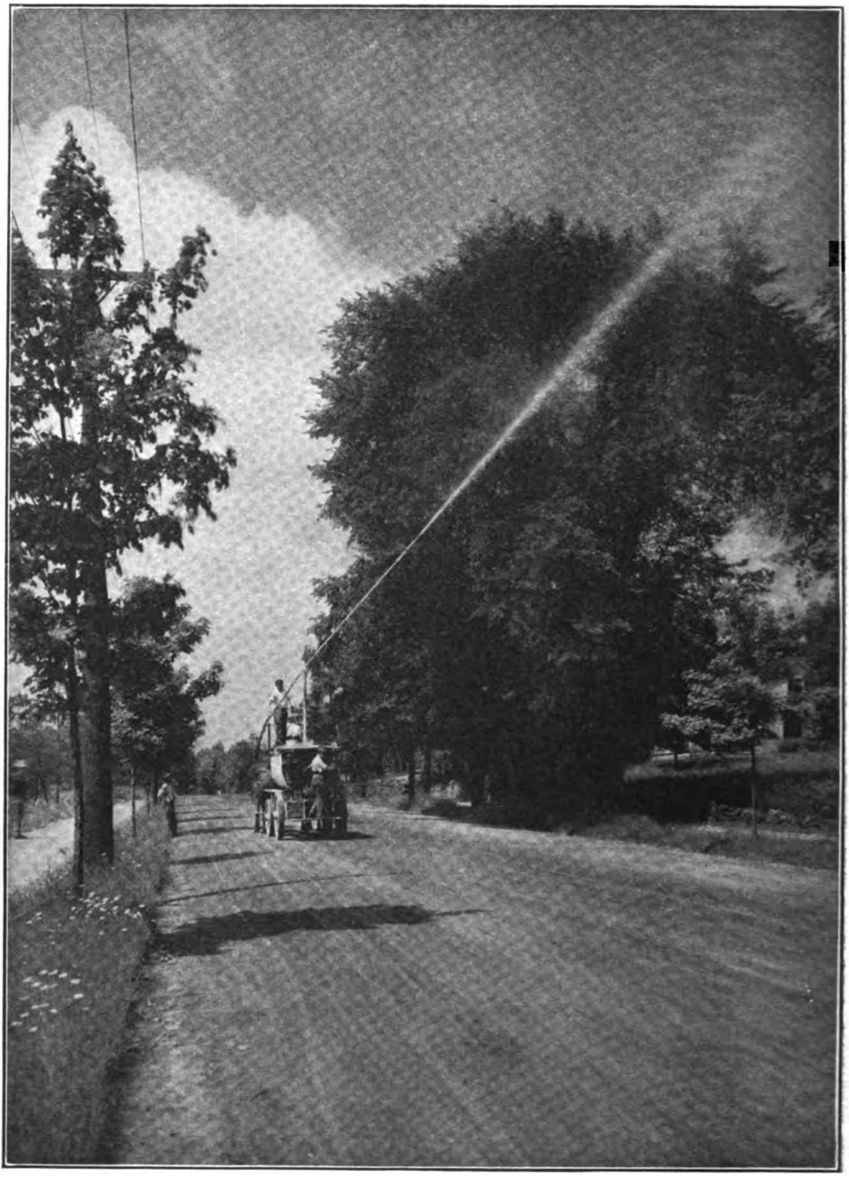

FIG. 9.—High-power spraying outfit in use in treating roadside trees. (From Rogers and Burgess.)

will probably be necessary to creosote egg clusters in the winter and spray in the spring if the insect is to be controlled. In any case thoroughness is a prime essential if good results are to be secured.

All poor or hollow trees should be removed, and if badly infested woodland is near by the orchard trees should be banded with tanglefoot. Orchard infestations can be managed by following up these methods, and it will not require much additional expense or a great deal of extra work to protect the trees. In making this statement it is assumed that the orchard is being cared for by up-to-date methods in order to protect it from the codling moth and other injurious insects and diseases, and it is improbable that these results can be brought about in neglected orchards or where the owners do not practice the best horticultural methods in handling their growing trees.

HAND METHODS FOR CONTROLLING THE GIPSY MOTH IN CITIES AND TOWNS.

The same methods that are used in orchards are applicable in cities and towns and for the treatment of park and shade trees. In certain instances it would probably be advisable to use tanglefoot bands or burlap, preferably the former, and to discontinue spraying in cases where the infestation is light or moderate. If the infestation is bad, creosoting, tanglefooting, and spraying should all be used in their season, in order to bring the insect under control and reduce the numbers present to a minimum.

The proper method of handling the gipsy moth in any town, city, or park or on private estates, should be based on the infestation as determined by some one who is familiar with gipsy-moth work, if the best results are to be secured at a minimum expense. Much energy and money may be wasted in applying remedies unless their application is based on a thorough knowledge of existing conditions. An owner of an infested estate should have an examination made by some qualified person who can give reliable recommendations as to treatment. It should be borne in mind that conditions as to infestation vary from year to year, and this should be considered when plans for treatment are being made.

METHODS OF CONTROLLING THE GIPSY MOTH IN WOODLAND.

Satisfactory control of the gipsy moth in woodland by the employment of hand methods such as have already been mentioned is entirely impracticable unless the tree growth is particularly valued for purposes other than lumber. If the woodland is situated near a large city and occupies space that is likely to be utilized in a few years for building lots, considerable money may be expended to advantage in protecting the trees, as these will make the property much more valuable when the land is subdivided. Limited areas of woodland on private estates may be of sufficient value to the owners to justify a considerable expenditure for moth destruction. In all cases, however, the species of trees involved should be carefully studied before a plan of work is adopted in order that the expense may be reduced as much as possible. Unfortunately the difficulty of treating the woodlands in the infested area of New England is considerably increased by the fact that they are for the most part composed of a variety of species in mixture.

Experiments have shown that coniferous trees are not injured by the gipsy moth if grown in isolated pure stands, and if the growth is such that the trees can be thinned to a stand of conifers no hand suppressive measures are necessary in order to prevent injury by this insect. (See fig. 10.) Such lots will also be immune from attack by the brown-tail moth, as the larvæ of this insect do not feed on conifers.

If mixtures containing a large percentage of deciduous trees are to be protected from moth injury it is very necessary that the species involved should be carefully considered before a decision is reached as to the best methods of treatment. Sometimes practical methods of thinning can be adopted so that species will be left that are only slightly subject to injury by these insects. A limited number of experiments have shown that mixtures of chestnut, pine, red maple, ash, and hickory, regardless of the proportion of each species, are seldom injured by the gipsy moth.

In woodlands the oaks are the most favored food plant of this insect, and unfortunately the infested region abounds in large areas where these species predominate. At present there seems to be no means aside from hand treatment which will prevent serious injury to oak woodland, but as a large part of such land consists of poor sprout growth the amount of damage sustained is not always so great as it might at first appear. The greatest injury likely to be caused in such areas where oaks and gray birch abound is the dying of small seedlings of pine or other valuable species which have been denuded by the caterpillars after the oaks and birches have been defoliated. This leaves the prospective woodland in a much worse condition than it was before the defoliation took place and reduces greatly the chance that the sprout growth will be replaced by any species of value that can withstand gipsy-moth attack. This problem is being given special study and consideration in the hope that some economical method may be devised for protecting and improving wood lots of this character at moderate expense. It is true that there are considerable areas of oak woodland where the trees, although not mature, could be utilized for small timber, railroad ties, or cordwood, and in cases of bad infestation such woodland should be promptly cut if the wood can be sold to advantage. On cheap cut-over or infested lands in many sections of the territory planting of white pine might be carried on to advantage, but as this involves considerable expense and as the future crop can not be harvested for a period of years the question as to the desirability of managing

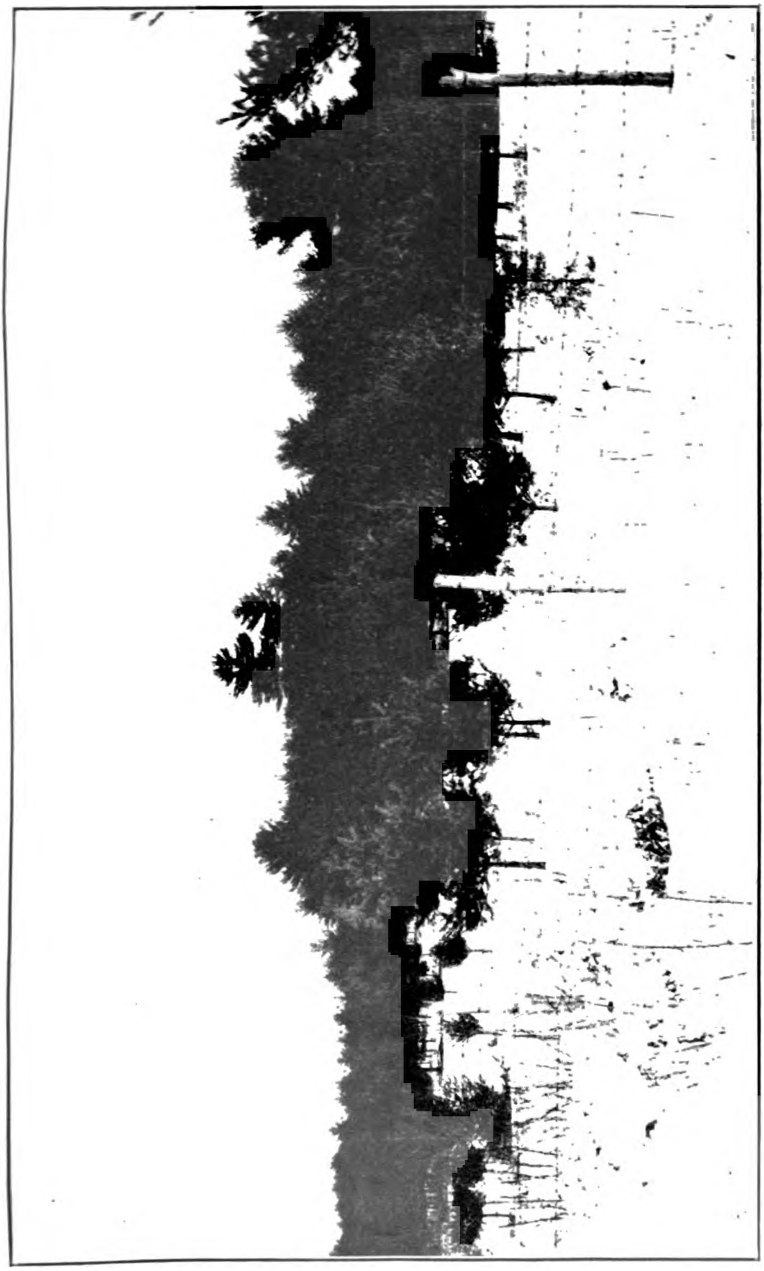

FIG. 10.—Solid white-pine block near Nashua, N. H.: Small trees in foreground were transplanted some years ago. The foliage of this species is not attacked by *small* gipsy-moth larvæ, so it is not injured if grown in clean stands. (Author's illustration.)

any wood lot in this way must in the end be decided by the owner of the property.

If the practice common in some European countries of maintaining municipal or state forests were well developed in the New England States it would be possible in a period of years to transform considerable areas of land which are now destined to be worthless, and which form a favorable feeding ground for the gipsy moth, into well-managed forests of valuable growth.

METHODS OF CONTROLLING THE BROWN-TAIL MOTH IN WOODLAND.

The damage caused by the brown-tail moth is ordinarily not so severe as is that resulting from gipsy-moth infestation because the former species does not have so wide a range of food plants and, further, because the bulk of the feeding is done early in the season so that the trees have an opportunity to recover before midsummer. In the territory where both insects exist the caterpillars of the gipsy moth supplement the work which is done by those of the brown-tail moth and the injury is therefore greatly increased. The large areas of oak-sprout growth furnish abundant food for brown-tail moth caterpillars, and as a result enormous numbers of the moths develop which migrate each season to the cities and towns and render it necessary for hand suppressive measures to be put in force each year. The area reinfested in this way depends largely on the prevailing winds during the month of July when the moths are flying. Elimination of oak, scrub apple, and wild-cherry trees would assist greatly in reducing the numbers of this pest.

STATE WORK AGAINST THE GIPSY MOTH AND THE BROWN-TAIL MOTH.

Each of the New England States is carrying on work for the control of these insects. The organization varies, as between the States, owing to differences in local conditions, but the same general methods of work are employed. A brief summary of the conditions of infestation in each State follows, with a statement of any special lines of work that are being attempted and the name and address of the State official in charge. Particular information concerning local conditions may be obtained by communicating with these officials.

Maine.—The work in Maine is in charge of the State commissioner of agriculture, who has authority to appoint a superintendent of moth work. The area badly infested by the gipsy moth is relatively small, but scattering infestations have been found throughout the southern part of the State. The entire area embraces about 4,850 square miles. Infestation by the brown-tail moth covers 12,450 square miles in the State. This species is a particularly serious pest in the southern part of this territory and causes much injury and financial loss to the famous watering places along the coast. A moderate amount of work is being carried on each year by some of the towns in the infested area, but more should be done since under present conditions the residential sections can not be handled satisfactorily with the amount of funds available. State work is being carried on in the worst infested sections. The superintendent of moth work of Maine is Maj. E. E. Philbrook, Portland, Me.

New Hampshire.—Work in New Hampshire is in charge of a State agent appointed by the governor. Infestation by the gipsy moth throughout the southern part of the State is very heavy, and large areas of woodland have been completely defoliated during the past few years. The total area known to be infested by this insect is 4,960 square miles. The range of the brown-tail moth in New Hampshire is 8,100 square miles, and much loss has been caused during the past few years to the owners of woodland and summer property. Fortunately neither of these insects has become established in any great numbers in the White Mountain section of the State. Many of the towns in New Hampshire are cooperating with the State agent in an attempt to reduce the infestations, and progress in some sections is quite marked. The State agent is also carrying on a series of demonstration cuttings in wood lots in order to induce farmers and others to manage their woodland so as to prevent future moth injury. Prof. W. C. O'Kane, Durham, N. H., has charge of the work.

Vermont.—So far as is known, the gipsy moth does not occur in Vermont, but the brown-tail moth has become established in small numbers in several tiers of towns west of the Connecticut River. The work is in charge of the commissioner of agriculture, who has appointed a field deputy to look after the handling of infestations. The whole area known to be infested embraces about 2,635 square miles. Most of this infestation is recent, and owing to the thorough work done in the spring of 1913 it seems probable that the infested area will be reduced. Mr. E. S. Brigham, commissioner of agriculture, St. Albans, Vt., has charge of the work.

Massachusetts.—Moth work in Massachusetts is in charge of the State forester, but the law requires that each infested town shall appoint a local superintendent, subject to the approval of the State forester, who shall take charge of the work in his locality. The area infested by the gipsy moth in this State is 4,975 square miles. The brown-tail moth infestation covers 6,510 square miles. Each property owner is required by law to expend not to exceed $5 on each $1,000 valuation, and additional work is done in each town and paid for locally. The State appropriation is made in such a way that a certain amount of State funds can be used to assist towns which are most seriously infested or financially least able to bear the burden.

Aside from having general supervision over the entire work in Massachusetts, the State forester takes active charge of suppression work in certain sections of the State where money is subscribed by residents or interested parties for that purpose. Experimental and demonstration work is also being carried on by him with a view to so modifying the forest growth that it will be resistant to moth attack. Prof. F. W. Rane, 6 Beacon Street, Boston, Mass., is State forester.

Rhode Island.—Moth work in Rhode Island is in charge of the State board of agriculture and is placed by it under the supervision of the State entomologist. The gipsy moth infestation covers an area of 450 square miles. Brown-tail moth infestation covers the entire State—1,250 square miles. The gipsy moth infestation is not serious except in the region in and surrounding Providence, but infestation by the brown-tail moth has been worse than usual during the past year. The State entomologist is carrying on suppressive measures over as large an area as possible, but only a limited amount of local work is being done by the towns and cities to prevent injury by these insects. Prof. A. E. Stene, Kingston, R. I., is State entomologist.

Connecticut.—The moth work in Connecticut is in charge of the State entomologist. Only two gipsy moth infestations are known in the State and these have been practically exterminated. The brown-tail moth infestation covers a territory of about 1,475 square miles, and the area has increased considerably during the past year. Careful scouting has been done in all these towns and much thorough work by the State in order to reduce the infestation. At present no system of town or local moth work is in force in Connecticut. The State entomologist is Dr. W. E. Britton, New Haven, Conn.

New York.—A small colony of the gipsy moth was found in Geneva, N. Y., in 1912. Effective work has been done by the State department of agriculture, and the insect is now believed to be exterminated. A close watch will be kept on this locality for several years so that if any of the insects have been overlooked they can be promptly treated. Mr. George G. Atwood, chief horticultural inspector, Albany, N. Y., has charge of this work.

WORK CARRIED ON BY THE BUREAU OF ENTOMOLOGY.

The work carried on by the Bureau of Entomology of the United States Department of Agriculture is designed to prevent the spread of these insects. Owing to the freedom with which the female brown-tail moth flies it is difficult to prevent spread by hand suppressive means, as a heavy migration may take place into new territory during any year when the wind is favorable at the time the moths are flying. The spread of the gipsy moth has been much slower, but infestations are being found in territory along the line of the prevailing winds when the gipsy moth caterpillars are hatching in the spring. It has been proved experimentally that the caterpillars, immediately after hatching, can be blown long distances, and of course such spread is very difficult of prevention. Fortunately the caterpillars must be active or they will not be caught up by the wind, and no activity is possible unless the temperature is high. From this it results that most of the wind spread is toward the north and northeast, so that the danger of spread by wind to territory outside of New England is not serious at present.

The work of the bureau is being carried on along several distinct lines, namely, experimental work, silvicultural investigations, quarantine work, and scouting work. The experimental work is conducted for the purpose of obtaining information which will serve as a basis for better control methods. It includes a thorough study of the food plants of the insects concerned and of the feeding habits of the caterpillars in their different stages, the rate of increase in the field, the means by which the insects are spread, the introduction and distribution of the foreign parasites and natural enemies of these species, and a study of the wilt disease, which has now become a prominent factor in reducing the infestation in many localities. The last investigation is being carried on cooperatively with the Bussey Institution of Harvard University, and Dr. W. M. Wheeler, who has charge of the economic entomology in that institution, is supervising the technical aspects of the work. A study is also being made, in cooperation with Dr. A. D. Hopkins, who has charge of the Forests Insect Investigations of this bureau, of the secondary insects which attack defoliated trees.

Silvicultural investigations are being carried on in cooperation with the United States Forest Service. Mr. G. E. Clement has been assigned from that service to this bureau for the purpose of conducting experiments to determine whether better silvicultural practices and improved methods of forest management can be employed as a help in checking the spread of these pests.

The entire infested area—15,235 square miles occupied by the gipsy moth and 32,420 square miles occupied by the brown-tail moth—has been placed under quarantine by the Federal Horticultural Board, and shipments of nursery stock, lumber, cordwood, and other forest products are not permitted to leave the territory unless they have been inspected and are accompanied by a certificate stating that they are free from infestation. This work is designed to prevent the spread of the insects for long distances and is being administered by Mr. D. M. Rogers.

The scouting work consists in making examinations in the towns outside the infested area and is directed by Mr. L. H. Worthley. This work serves to establish the quarantine line. It is the policy of the bureau to carry on as much work as possible in the territory along the western border, for the purpose of stamping out new colonies that may become established and to prevent, so far as possible, further spread of the insect in this direction. A large number of men are employed on this work, and all the towns along the border were given attention this year from Lake Winnipesaukee on the north to Narragansett Bay. The work is carried on with special reference to the gipsy moth, as it would be impracticable to attempt control of the brown-tail moth in this way.

COOPERATIVE WORK.

Since work on the gipsy and brown-tail moths was begun by this bureau a greater or less amount of cooperative work has been carried on with the States concerned. As previously stated, the attempt to introduce parasites and natural enemies of the gipsy moth was conducted cooperatively with the State of Massachusetts for several years. Recently this entire line of work has been managed by the bureau, it being really a problem in which all the States concerned are vitally interested. During the past year Maine and New Hampshire have assisted in the work of collecting parasitized material and liberating it within their borders. The field work and the quarantine work is also carried on to a greater or less degree by means of cooperative arrangements with the States concerned, and since the work was first begun the relations with the various States have been very friendly and harmonious. Parasites have been liberated in greater or less numbers in all of the New England States.

THE OUTLOOK.

During the past season conditions in the oldest infested area have not been as serious as in previous years. The records show that the mortality of the gipsy moth and brown-tail moth caterpillars as a result of the attack of parasites, predaceous enemies, and disease has been greater than in any of the years preceding. The experiments which are being conducted are giving information which will serve as a basis for handling infestations more satisfactorily and economically, and although new territory has been found infested the outlook for diminishing the aggregate amount of damage which results from the work of these insects is more favorable than it has been heretofore. It is necessary, however, that aggressive measures should be continued in order that the pests may be brought under better control. This is of vital importance, particularly to the citizens of States where these insects do not now exist.

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FARMERS' BULLETIN
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January 22, 1914.

CORN MEAL AS A FOOD AND WAYS OF USING IT.

By C. F. Langworthy, Ph. D., Sc. D., *Chief of Nutrition Investigations*, and
Caroline L. Hunt, A. B., *Expert in Nutrition.*

University of Virginia
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1914

INTRODUCTION.

The intelligent use of a given food material, such, for example, as Indian corn, which forms the subject of this bulletin, calls for some knowledge of its nature, properties, and food value, and also some understanding of the possibilities of its use as compared with other foods which make up the ordinary dietary. The increasing variety of foods at the disposal of the housekeeper, resulting from improved methods of agriculture and marketing, from more extended food manufacture, and from the introduction of new foods is contributing pleasing and healthful variety to the diet. It also offers a temptation to complicate the diet to a degree undesirable from the point of view of either health or economy of time. In the face of this temptation intelligent housekeepers and those who cater wisely for larger groups of people, in schools or other institutions, are seeking to secure the advantages, without the disadvantages, of the large number of available foods which include the old and well tried as well as the new.

If the meals of the average family are analyzed, each will be found to contain one or more foods—meat, fish, poultry, cheese, or a legume—distinguished from others by a high percentage of tissue-forming material; one or more foods distinguished from others by a high percentage of fat—butter, oil, or cream; and one or more foods—bread perhaps, or potato, or rice, or a prepared cereal—distinguished from others by a high percentage of starch. This by no means exhausts the groups, but it goes far enough to suggest how a meal is usually made up and also to point out that variety can be secured in two ways, either by multiplying the representatives of the various groups in each meal (serving fish and meat in the same meal, for example, or potatoes and rice), or by limiting the representatives of each group and varying them from meal to meal. By the latter means variety would be secured through a succession of simple meals differing among themselves. The choice between the two methods must be determined to a large extent by the needs and tastes of the family or group for which the catering is done, but there can be no doubt that there is a tendency toward simplifying the individual meal and toward varying what we may call the "constants" from meal to meal or from day to day. In order to do this, a person must understand the various foods sufficiently well to be able to group them on the basis of their special uses.

It does not necessarily follow that multiplying the representatives of any given group means that one overeats of this group. With potatoes, rice, and sweet potatoes at the same meal, one would probably eat little more of all together than he would of one alone. He would surely secure more varied and well selected meals if vegetables of different types were served with one carbohydrate food instead of three carbohydrates at the same time. The assumption sometimes made in popular literature that the body is harmed by having several sorts of starch, for instance, supplied at any one meal, like other such statements, apparently has no foundation in fact.

The purpose of this bulletin is not to recommend Indian corn to the exclusion of other foods of its group, the cereals, which include wheat, rice, rye, and others, but to speak of its value as a food and its distinguishing qualities which call for special methods of cooking; and to show how it may be used to secure variety in one of the principal lines of food materials which make up the usual dietary.

ORIGIN OF INDIAN CORN.

Indian corn has special historical interest for Americans from the fact that it is generally recognized as being native to American soil. It was originally a tropical or subtropical plant, but the Indians, though unconscious of the trend of their attempts to extend corn growing, nevertheless succeeded in evolving varieties which would ripen as far north as Canada. Its cultivation and use, therefore, even in the early days were very widely distributed in America. With fish and game it made the staple food of the Indians, and except for wild rice, which grew abundantly in shallow fresh waters, and the seeds of certain wild grasses (both used in relatively small quantities), it was the only cereal known to them.

In all the history of America corn has played an important part. The desire to produce it was probably the incentive which most frequently led the Indians to abandon nomadic life and to form settlements. Because of the quickness and ease with which it can be raised, it was doubtless, too, the means of saving from starvation many of the pioneers who came from other lands to settle here. So important was this food in the days when the country was being settled, that both Indians and colonists in their controversies often found it more efficacious to destroy the corn crops of their adversaries than to make open war upon them.

After the discovery of America the use of corn spread rapidly to other countries, and it is now very generally raised in all regions of the world where it will flourish. So generally has it come into use that it now ranks with wheat, rye, barley, oats, and rice as one of the food grains of the world and may be called the American Indian's greatest gift to modern civilization.

COMPOSITION OF CORN.

A previous publication of this series[1] discusses at length the composition of corn and corn meal, corn breakfast foods, cornstarch, and other food products prepared from this grain, and this need not be considered in detail here. Some data of this sort are, however, briefly cited, since they have a bearing on problems of cooking corn meal and using it economically.

The table which follows shows the average composition of corn grain of different sorts and corn meal of different kinds:

Average composition of corn and corn-meal products.

Kind of material.	Water.	Protein.	Fat.	Carbohydrates.		Mineral matters.	Fuel value per pound.
				Starch, sugar, etc.	Crude fiber.		
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Calories.*
Corn, whole grain, average	10.8	10.0	4.3	71.7	1.7	1.5	1,795
Corn, white	11.4	10.8	5.0	68.8	2.5	1.5	1,690
Corn, yellow	11.9	10.7	4.8	68.9	2.2	1.5	1,690
Corn meal (whole grain ground), **unbolted**	12.0	8.7	4.7	71.1	2.2	1.3	1,850
Corn meal (whole grain ground), **bolted**	12.0	8.9	4.9	72.0	1.2	1.0	1,765
Corn meal, granulated (new **process**)	12.5	9.2	1.9	74.4	1.0	1.0	1,770
Corn flour, i. e., finely ground and bolted corn meal	12.6	7.1	1.3	77.5	.9	.6	1,645

On the basis of very numerous studies it can be stated that the different varieties of corn differ little among themselves in nutritive value, and that when fully ripened and matured the corn crops of various parts of the world are practically identical in composition. The average composition of corn refined and dried for grinding is given as follows: Water, 10.8 per cent; protein, which is of special interest because it is the nutrient which builds and repairs the tissues of the body, 10 per cent; fat, 4.3 per cent; starch and sugar, which with fat are the chief sources of energy, 71.7 per cent; crude fiber, 1.7 per cent; and mineral matter, 1.5 per cent. The fuel value, or, as it is often called, the energy value, is 1,795 calories per pound. When this composition is compared with the average composition of the common foodstuffs which make up the diet of the majority of people—meat, dairy products, vegetables, fruits, etc.—it is found to have a low water content, a low fat content, a fairly high protein content, a very high percentage of carbohydrates (chiefly starch), and very close to the average amount of mineral matter.

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[1] U. S. Dept. Agr., Farmers' Bul. 298.

Few people wish to remember the composition of foods exactly, but many, particularly housekeepers and others who are interested practically in the food supplies of families or other groups, wish to keep in mind in a general way the composition of the foods which they handle. For such people it will be sufficient to think of the composition of corn in terms of tenths: Seven of the tenths being starch; one, protein; one, water; and the other tenth being divided among fat, crude fiber, and mineral matter in approximately equal amounts.

COMPOSITION OF CORN COMPARED WITH OTHER CEREALS.

A detailed comparison[1] of the composition of Indian corn and other cereal grains (wheat, rice, oats, rye, barley, Kafir corn, millet, and buckwheat) shows that these cereals differ little among themselves in composition—so little, in fact, that save where great exactness is sought they can be considered as a group of interchangeable foods so far as their nutritive value is concerned. The average percentage of protein in them is 11, the extremes being 8 and 13 per cent. Indian corn, which has on an average 10 per cent protein, falls slightly below the average for the group. Its fuel or energy value, on the other hand, is the highest of all the cereals included in the list, being approximately 1,800 calories per pound, or about 100 calories above the average. An explanation of this is found in the percentage of fat, which is 4.3 per cent, the average in the cereals being about 2.5 per cent.

WHITE AND YELLOW CORN AND CORN OF OTHER COLORS.

As regards color, there are many varieties of corn—white, yellow, red, blue, and black. There is also some difference in the flavor of the different sorts, but, contrary to common belief, these varieties are, on the average, practically identical in composition, and differ little in nutritive value. White corn meal is, as a rule, milder in flavor than yellow. The preference for one sort or another, however, is a personal matter, and seems to be determined very largely by locality. White corn is generally preferred in the Southern States and in Rhode Island and yellow in the Northern States as a whole, while the blue, black, and red have always been used very largely in the Southwest, where Spanish influence is marked.

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[1] U. S. Dept. Agr., Farmers' Bul. 298.

CORN MEAL.

Changes in modern milling methods, with corresponding differences in the characteristics of corn meal, have given rise to the terms "old-process meal" and "new-process meal." As is the case with wheat flours, the character of the meal is largely influenced by the amount of the different parts of the grain retained in it.

A grain of corn is by no means uniform throughout in composition, but is made up of many parts differing greatly among themselves, not only in texture and consistency, but also in chemical composition. In general, it is sufficient to consider the kernel as consisting of three parts—skin, germ, and endosperm. The skin constitutes about 6 per cent of the whole weight of the kernel; the germ, which contains the embryo from which under favorable conditions new life will spring, about 10 per cent; and the endosperm, which is the storehouse of food for the new life, about 84 per cent.

An idea of the differences in composition of the different parts may be gained from data obtained with one variety of corn, but which can be regarded as typical. According to these figures the skin contains approximately 5.5 per cent protein; the germ, 15.3 per cent; and the endosperm, 9.2 per cent. In the case of fat the skin contains 1.4 per cent; the germ, 20.8 per cent; and the endosperm, 1.1 per cent. The percentage of sugar and starch (chiefly starch) in the skin is 62.8; in the germ, 31.5; and in the endosperm, 84; and the percentage of crude fiber 13.9, 2, and 0.5, respectively. To put the matter in another way, the skin contains 51 per cent of all the crude fiber in the kernel, the endosperm contains 90 per cent of all the starch, and the germ contains 16 per cent of the protein and 65 per cent of the fat. Removing the whole skin, therefore, would take away only six one-hundredths of the whole weight of the kernel but more than half the fiber. This would, of course, leave the remaining portion of the grain with a much smaller percentage of fiber than the kernel had originally. When the germ is removed, as it often is, by modern milling processes, the effect is to take away only one-tenth of the whole weight of the kernel but more than six-tenths of all the fat and one-sixth of the protein. It will be seen, therefore, that the removal of the skin and the germ would tend to reduce materially the percentages of cellulose and fat and somewhat the percentage of protein in the meal.

METHODS OF MILLING.

In order to soften the ripe, dry corn sufficiently to make it edible it has always been found necessary to crush it, the grain being sometimes parched or soaked so it would crush more easily. This was in the early times accomplished by pounding in a hollow log or by means of stones. Under most primitive conditions these stones were manipulated by hand. Later they were turned by water power, and the meals produced in this manner are called "water ground."

When the whole grain was crushed the resulting meal contained, of course, all of the skin, much of which is hard and unsuited for food. A second step in producing an edible and palatable product, therefore, was the removal of the bran so far as possible. This was done in early times by means of sieves and similar devices, or by winnowing, but the removal was far from complete, and the resulting meal did not differ greatly in chemical composition from the original grain; it was simply more convenient for use.

The removal of the bran by these primitive methods was somewhat wasteful, for much of the interior of the grain was also removed. Of late a method has been devised for kiln-drying the grain, after which the skin can be removed in one piece.

The fat in the germ, which when separated is called corn oil and is used in many ways in the arts and for culinary purposes, is peculiarly liable to become rancid. For this reason the older types of meal, which contained all the germ fat, were hard to keep in good condition. Modern milling processes, which substitute steel rollers for stones, flatten the germ without breaking it, thus making it possible to remove it whole. The effect of the removal of the skin and germ, as we have said, is to reduce quite materially the percentages of fat, cellulose, and mineral matter, and to some degree the percentage of protein. The removal of the germ, however, and the kiln-drying of the meal, which lessens or destroys molds and decay-producing bacteria, are not without their advantages, for they have the effect of improving the keeping quality of the meal.

USES OF CORN MEAL.

Data obtained in the nutrition investigations[1] of this department show that over 60 per cent of the food consumed by the people of the United States, on an average, is of vegetable origin, and that about one-seventh of this, or 8.7 per cent of the whole, is corn meal. Of the total protein consumed, animal as well as vegetable, corn meal supplies 10 per cent; of the total fat, 3.8 per cent; and of the total carbohydrates, 13.7 per cent.

Corn meal compared with other foodstuffs of a similar nature is a low-priced food material, and when used alone or with other equally low-priced foods makes economical dishes. Of these dishes, which consist often of meal, salt, and water only, each locality where corn is used in large amounts seems to have worked out its own peculiar form. The southern cook made hoecake, or corn pone or ash cake, cooking a dough of corn meal and water on a board before an open fire, or baking it in the ashes. The early New Englander had his "hasty pudding," made by cooking corn meal in a large amount of water. This was so made that when hot it was thin enough to be eaten as a mush with milk, and when cold thick enough to be fried in slices. The Italian has his polenta, which resembles hasty pudding, except that it is usually somewhat thicker and that a little fat is added.

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[1] U. S. Dept. Agr., Office Expt. Stas. Circ. 110.

RELATION OF CORN MEAL TO THE BALANCED RATION.

As the science of nutrition has developed, a term, "nutritive ratio," has been devised and used in the discussion of foods, of meals, and of dietaries. This refers to the ratio of protein to the other constituents present as sources of energy. The farmer has found a consideration of nutritive ratió of value in discussing his feeding problem, and it is equally useful for the housekeeper. When this is understood it is less easy to fall into a popular error and speak of protein as a tissue-forming substance, and of fat, sugar, and starch as fuels. The truth is that protein, too, is a fuel, and when taken into the body and utilized produces almost the same amount of heat, weight for weight, as either sugar or starch. Besides its power to produce heat, however, protein has another and most important use, which the fats and carbohydrates can not serve—that of providing nitrogen for building and repair material for the body tissues. It is often desirable to distinguish protein from the other nutrients, and this may be conveniently done by stating how much of the heat represented by a given food is provided by the tissue-forming substances and how much by those without nitrogen which serve as fuel. Such a statement is furnished in what is called the nutritive ratio. If the nutritive ratio of a food is stated as 1:6, we may understand that the fuel from the nitrogenous part of the diet available for tissue forming is one-sixth of that from the fats and carbohydrates.

The nutritive ratio of the ordinary diet of a person doing moderate muscular work is not far from 1:6, while the nutritive ratio of corn meal is about 1:10. In the well-balanced dietary, therefore, corn meal would naturally be combined with foods of higher nutritive ratio—with milk, meat, fish, eggs, or cheese, for example. That the tendency toward taking balanced rations is more or less instinctive is indicated in the case of corn meal by the fact that almost every locality which uses this food material in large amounts has a characteristic dish in which corn meal is combined with a substance richer in nitrogen. Probably the best known of these dishes in this country are succotash—in early times made of dry corn and beans as well as of the green—and the mush and milk of the earlier settlers of New England, and the hoecake and buttermilk of the South. It was the custom of the American Indians in early times to combine corn meal with the fish and meat which they brought back from the chase. It is said that they used for this purpose shad, eel, alewife, and other kinds of fish and the flesh of deer, beaver, bear, moose, otter, and raccoon. While it is obviously impossible to give the exact nutritive value of foods which vary in composition as both corn meal mush and milk must necessarily vary, it is safe to say that equal volumes of corn meal mush and milk form a ration which satisfies very nearly the physiological requirements of the body as these are understood to-day.

Another apparently instinctive attempt to secure a balanced ration is the dish known as "scrapple," for which a recipe is given later in the bulletin. This is made by cooking corn meal in the water in which pork (usually a pig's head) has been boiled and combining this mixture with the finely chopped pork. The addition of the meat, which consists largely of protein and fat, to the corn meal, of which starch is a prominent ingredient, tends to produce a balanced ration. "Stamp and go," a favorite dish among the natives of Jamaica, is made up of salt fish, lard, and corn meal, and has a nutritive value resembling that of scrapple. The use by the Italians of cheese, which consists chiefly of protein and fat, with a sort of mush called polenta, may be considered another instinctive attempt to satisfy the physiological food requirement by means of a single dish.

COMBINATION OF CORN MEAL WITH MORE HIGHLY FLAVORED FOODS.

All those who use corn meal in large quantities have apparently sought also to combine this neutrally flavored food with others of pronounced flavor. The Zuñi Indians have a dish which is called "hot cakes" which they make by combining corn meal with water and suet and adding a large amount of red pepper. In the United States it was a common custom in older times to vary many of the corn-meal dishes by the addition of tart apples (see p. 20), while in Italy polenta is usually served either with a highly seasoned sauce or with cheese.

THE COOKING OF CORN MEAL.

A study of the modifications in methods of cooking, which have been rendered necessary by the changes in the composition of the meal, was made a few years ago at Teachers College, Columbia University, New York City, for the Office of Experiment Stations. The result of these investigations, which are still unpublished, may be summarized as follows:

In general it was found that about 10 per cent more water was needed for the new-process meal than for the old process, and that where the large amount of water used renders the meal liable to sink, the mixture of meal and water should be thoroughly heated before being used for such preparations as bread. In some cases, too, it was found best in using new-process meal to pour the meal into a dish of boiling water instead of pouring the boiling water over the meal in a cold dish, for this brings the mixture to a higher temperature.

In later experiments made in the Office of Experiment Stations it was found that in some cases, notably in that of making quick-process breads out of yellow corn meal, pouring the meal into hot water was insufficient. In these cases it seems necessary to hold the dish of moist meal over the fire for a few seconds.

When convenience, as well as the final results, was taken into consideration, it was found best in almost every case to mix the meal with cold water and to heat it thoroughly over boiling water in a double boiler. Except when very finely ground meals were used, it was found unnecessary to stir at any time, not even when the meal and water were put into the boiler. The conclusion was reached, in fact, that in all cases, even those in which the liquid used was not water, but either sweet or sour milk, the best results were obtained by heating the meal and liquid together in a double boiler without stirring. For example, sour-milk corn bread, the recipe for which is given on page 17, was prepared first according to the directions usually given in the cookbooks, i. e., by mixing the dry ingredients and then adding the sour milk, butter, and eggs. Then, for the sake of comparison, the same ingredients were combined by heating all of them but the soda and eggs for 10 or 15 minutes in the double boiler. After the mixture had cooled, the soda, dissolved in a little water, and the eggs were added. The bread prepared by this second method had a better flavor, and, though more moist than that prepared by the first method, held its shape quite as well.

Since the composition of the new-process meal differs from that of the old-process meal in having less fat as well as less water, it is desirable to make allowance for this when using the new meal. In making such simple dishes as hoecake and corn-meal pone, which originally were prepared from the meal and water alone, a little lard or butter should be added and in other dishes the allowance of fat should be slightly increased.

CORN-MEAL MUSH AND SIMILAR DISHES.

In making corn-meal mush, or "hasty pudding," with water, allow three and one-half times as much liquid as meal; if milk is used, allow four or more times as much as of meal. Recipes for making this dish almost invariably direct that the meal be poured into boiling water, either in dry form or mixed with cold water or milk. Directions for preparing the corresponding Italian dish—polenta—often state that the mixture should be constantly stirred, and sometimes include the most careful and minute instructions about the character of the dish and spoon to be used, and other details. The fact is that these precautions are seldom necessary, for if corn meal and cold water are brought together without being stirred and the mixture is heated gradually and gently it does not lump. The most convenient utensil for the purpose is a double boiler, but the cooking can be done satisfactorily over the fire, providing the temperature is kept low. The elaborate directions usually given in the cookbooks appear to be quite unnecessary, and there seems to be no reason for running the risk of making the porridge lumpy by pouring the meal into hot water. Nor is there any reason for having the mush stick to the dish and thus complicate the work of dish washing, as it does when the meal is cooked for a long time in a dish without water under it. If cooking over hot water is not thought to insure sterilization of the meal, the mush can be boiled after it has been cooked in the double boiler for a short time and the danger of lumping has passed.

The method of making corn-meal mush has been described above. There are many ways of using it besides serving it with milk or cream. It is often eaten with maple sirup, molasses, or other sirup, or with honey and butter. It may be fried and used alone or as an accompaniment of other dishes. A number of recipes for preparing corn meal and using it in the preparation of other dishes follow:

CORN-MEAL MUSH.

1 cup corn meal.
1 teaspoon salt.
3½ cups water or
4 cups milk or milk and water.

Put all the ingredients into a double boiler and cook for 4 hours.

CORN-MEAL MUSH MADE IN A FIRELESS COOKER.

1 cup meal.
1 teaspoon salt.
4½ cups water, milk, or milk and water.

Mix the ingredients and bring them to the boiling point. Place the pail in the cooker and leave for from 5 to 10 hours. If the pail holding the mush is set into another pail of hot water before being placed in the cooker, the heat will be retained better, but whether this is necessary or not depends on the efficiency of the cooker.

Because of the long cooking which corn meal requires, it is often convenient to prepare it in a fireless cooker. It is, in fact, peculiarly adapted for this method of preparation, for, like all finely divided foods which are cooked in water, it can easily be brought to a uniformly high temperature, and there is no danger, as there is in cooking large pieces of meat, for example, that some parts will be cool when the food is put into the cooker. The large amount of water with which it is combined is also of advantage, for water has a very high specific heat, and for this reason cools off comparatively slowly. In cooking corn meal in the fireless cooker, 5 hours at least should be allowed.

POLENTA.

This dish, which is common in Italy, differs little, except in name, from hasty pudding, though it is served in very different ways. Sometimes cheese is added during the cooking. Polenta is often reheated either with tomato sauce, or a meat gravy left over from a meal or with a meat gravy made from a small amount of meat bought for the purpose, or with half tomato sauce and half meat gravy. In any case, the dish is improved by sprinkling each layer of polenta with cheese. When the polenta is to be reheated in gravy, it is well to cut it into small pieces in order that the gravy may be well distributed through the dish.

SAUCES FOR POLENTA.

TOMATO SAUCE.

2 tablespoons butter.	1 cup thick strained tomato juice.
2 tablespoons flour.	Salt and pepper.

Melt the butter; cook the flour thoroughly in it; add the tomato juice and seasonings; and cook until smooth, stirring constantly.

SAVORY SAUCE.

Take 2 ounces of salt pork, bacon, or sausage. If bacon or pork is used, cut it into small pieces. Heat until crisp but not burned. In the fat which tries out of the meat, cook a small amount of finely chopped onion and red or green pepper, being careful not to burn them. Add 1 cup of thick tomato juice or a larger amount of uncooked juice, and cook the mixture until it is reduced to a smaller amount. Season with salt. To this sauce capers, mushrooms, or finely chopped pickle may be added.

FRIED CORN-MEAL MUSH.

The custom of packing hasty pudding in granite pans, cutting it into slices, and frying it, is too common to call for special mention here. A less common method in this country is that employed in Italy where polenta is usually spread out in thin layers on a board and cut into small blocks. These blocks are egged and crumbed, and fried in deep fat. Another method is to mix corn meal in three times its volume of water and to cook it in water only long enough to form a mush, and to complete the cooking by frying the meal in butter or other fat. This is not so stiff as ordinary fried corn-meal mush, and has the advantage of requiring a shorter time for its preparation, as the temperature of fat suitable for frying is far greater than that of boiling water.

ROAST PORK OR FRIED CHICKEN WITH CORN-MEAL MUSH.

Blocks of fried corn-meal mush are sometimes served with roast pork, and are a common accompaniment of fried chicken, particularly in the Southern States. The mush is made by the usual method, is cooled and cut into slices, and fried a delicate brown either in a greased pan or in deep fat.

For a boiled corn meal and apple dumpling to be eaten with roast pork, see page 23.

ROAST PORK WITH BATTER PUDDING.

A dish corresponding to the Yorkshire pudding which is frequently served with roast beef can be made out of corn meal to serve with roast pork.

One-fourth cup corn meal.	One-half teaspoon salt.
1 cup milk.	2 eggs.

Place the milk, corn meal, and salt in the top of a double boiler and cook them about 10 minutes, or until the meal has expanded to form a homogeneous mixture. After the mixture has cooled, add the eggs well beaten. Grease gem tins thoroughly, allowing to each about 1 teaspoon of fat from the roast pork. Bake in a moderate oven, basting occasionally with the drippings of the pork.

CORN-MEAL MUSH WITH FRUIT.

Corn-meal mush is often served with dried fruits, particularly with figs and dates. In preparing such fruit for use with the mush, it is usually necessary to soften it. This can easily be accomplished by washing the fruit and then heating it in a slow oven. As a result of the heat the water remaining on the fruit is absorbed and the fruit softened and also dried on the surface.

CORN-MEAL MUSH WITH CHEESE.

For this dish yellow corn meal is usually used. For a mush made with 1 cup of yellow corn meal the usual allowance is one-half cup, or 2 ounces, of grated cheese. There is, however, no limit to the amount of cheese which can be added, and the addition of the cheese tends not only to make a more highly nitrogenous and nourishing dish, but also to make a dish which can be eaten without the addition of butter or cream. Like the ordinary corn-meal mush, it is often fried either in deep fat, after having been egged and crumbed, or in a small amount of fat.

BUTTERMILK CORN-MEAL MUSH.

White corn meal cooked in buttermilk makes a dish which resembles cottage cheese in flavor. It may be eaten hot, but is especially palatable when served very cold with cream. For this purpose it is sometimes molded in cups. In making it, allow 1 part of corn meal to 6 parts of buttermilk, and 1 teaspoon of salt to each cup of meal.

BAKED CORN-MEAL MUSH.

When corn-meal mush is partly done pour it into shallow pans, making a layer not more than 2 inches thick, and cook in an oven until it is well browned. The product secured is very similar to the original "Johnny cake," which seems to have been simply a corn-meal mush cooked in the oven, or, in some localities, fried. The name, however has with time come to be applied to a very large variety of corn breads.

CORN-MEAL DUMPLINGS

2 cups corn meal.	Boiling water.
1 teaspoon salt.	Flour for dredging.

Mix the meal and salt; pour boiling water over the meal and stir thoroughly, using water enough to make a thick paste. Form portions of the paste into flat dumplings about 3 inches in diameter. Have ready a kettle of boiling water and drop the dumplings in carefully, cover, and cook 20 minutes. These dumplings are often cooked with turnip tops or other greens, with or without the addition of a ham bone or a piece of fat pork. Some cooks dredge the dumplings with flour before boiling them.

CORN MEAL AND MEAT DISHES.

There are a number of dishes made from corn meal and meat or fish in which mush is used, or which resemble mush in some particulars. Recipes for such dishes follow:

Corn-Meal Mush with Pork.

1 pound lean pork, part meat and part bone.
1 cup corn meal.
1 teaspoon salt.
One-half teaspoonful powdered sage.
Water.

Cook the pork in water until the meat can be easily removed from the bone. Remove the meat, cool the broth, and remove the fat. Reduce the broth to about a quart, or add water enough to bring it up to this amount, and cook the corn meal in it. Add the meat finely chopped and the seasonings. Pack in granite bread tins. Cut into slices and fry. Beef may be used in the same way.

Corn-Meal Scrapple.

1 pig's head split in halves.
2 cups corn meal.
Salt and sage.

Follow the above directions for cooking corn meal with pork, but use double the amount of water.

Corn-Meal Fish Balls.

2 cups cold white corn meal mush.
1 cup shredded codfish.
1 egg.
1 tablespoon butter.

Pick over the codfish and soak it to remove salt, if necessary. Combine the ingredients and drop by spoonfuls into hot fat. Drain on porous paper. These codfish balls compare very favorably in taste with those made with potato and are more easily and quickly prepared.

Chicken and Corn-Meal Croquettes.

1 cup white corn meal mush.
1 cup chopped chicken.
Few drops onion juice.
1 egg.
Salt and pepper.

Combine the ingredients and drop by spoonfuls into hot fat.

White corn meal may be very satisfactorily combined with other kinds of cold meat to make croquettes. In general, corn-meal croquettes need not be egged and crumbed like ordinary croquettes, for the hardening of the corn meal on the surface of the mixture forms the necessary crust.

TAMALES.

Meat from ½ boiled chicken.
1 clove garlic or ½ medium-sized onion.
One-fourth teaspoon cayenne.
1 teaspoon salt.
1 cup corn meal.
2 or 3 small red peppers.
Corn husks.

Chop the chicken; season with the cayenne pepper, garlic, or the onion finely chopped, and salt; form the meat into little rolls about 2 inches long and three-fourth inch in diameter. Pour boiling water over the meal and stir; use water enough to make a thick paste. Take a heaping tablespoon of the paste, pat it out flat, and wrap a roll of chicken in it; then wrap each roll, as made, in corn husks which have been softened by immersion in hot water, tying the husks with a piece of string close to each end of the roll. Trim off the ends of the corn husks, allowing them to project an inch or two beyond the rolls. Cover the rolls with the broth in which the chicken was cooked, or with boiling salted water. Add two or three small, sharp, red peppers, and boil for 15 minutes.

Tamales are usually made with chicken but other meat may be used if desired.

CORN-MEAL BREAD.

It is difficult, if not impossible, to make a good yeast bread out of corn meal alone. In order to understand the problems involved, it is necessary to know something about the protein, particularly how it differs from the protein of other cereals commonly used in the preparation of yeast bread. It should be remembered that the word "protein" is not used to designate any one substance of unvarying characteristics, but is applied to mixtures of many nitrogenous substances which are found in almost every natural food product. It is possible, therefore, for the protein of two food materials, corn and wheat for example, to be the same in quantity, but to differ widely in quality.

The chief proteid of wheat, "gluten," is a mixture of substances which, when combined with water, makes a peculiarly sticky and tenacious mass that tends to hold any gas which is introduced into it. It is because of the presence of gluten that it is possible to make a porous loaf out of wheat and water.

The protein of corn, on the other hand, is totally lacking in the quality of tenacity, and so the somewhat granular particles of meal tend to separate readily. While this is an advantage in the preparation of some dishes, as stated above, it is a disadvantage in others, for any gas which is introduced into the moist meal escapes easily without rendering the mass porous. In fact, if eggs are not used with the meal, a certain amount of flour must be introduced if the bread is to be light and porous. The early settlers of this country discovered the advantage of adding rye to the corn, which helped to keep the bread moist, as well as to hold the gas bubbles due to the growth of the yeast. Ordinary wheat flour is very commonly used for this purpose with corn for bread making, but in tests which were made in preparing this bulletin the best results were obtained with gluten flour, which is made from wheat by removing a certain amount of starch, and in which the percentage of gluten is high. Gluten flours differ in composition depending upon the amount of starch which has been removed. To really warrant the name "gluten flour" the protein content should be at least 35 per cent, as prescribed in the Standards of Purity for Food Products.[1] The flour with which experiments were made in this laboratory contained about 30 per cent of protein as compared with 12 to 14 per cent in ordinary wheat flour. It cost 14 cents a pound, and the combination of three parts of corn meal, which was at that time 3½ cents a pound, with one part of gluten flour, made a mixture which averaged 6 cents a pound, a little more than the price per pound of wheat flour at that time. Samples of bread made from this mixture were analyzed and their protein content was found to average about 10 per cent as compared with 9 per cent usually found in wheat bread. It was of good color and flavor.

Even those breads which are made by combining corn meal with gluten or rye flour can not be handled like the breads made from wheat flour. The process is, in fact, very much shorter. The dough is placed in the pan immediately after being mixed and molded and should be baked as soon as the loaf is fully risen. The shape of the pan, too, is important, for it must have high sides, which will support the loaf after it has risen to its full height.

F. P. Dunnington,[2] in a report of a study of "The grinding of corn meal for bread," gives the data of experiments in preparing the simplest forms of corn bread, those consisting either of meal, salt, and water only, or those consisting of these ingredients with a little fat. He tested a large number of samples secured from mills in many parts of the country, North as well as South, and reported that the inferiority of some meals, as compared with others, for the purpose of preparing the kinds of bread with which he was experimenting, was due to the fact that they were too finely divided. He recommends that when meal is too fine to make light bread of this sort a small amount of baking powder be added.

Corn-meal breads, though of great variety, when the agencies by which they are made light are considered, fall into three classes: Those raised by air beaten into them, those raised by baking powder or soda, and those raised by yeast. The granular character of the meal favors the making of the first kind, for, as we have seen, there is nothing corresponding with the gluten of wheat to hold the particles together and to prevent them from being driven apart by the expansion of the air. Such breads are best made from the coarser meals and are usually very simple in character, often containing nothing more than meal, salt, and either water or milk. A small amount of fat is, however, sometimes added. They are light in texture but not porous. In breads of the second class, which are made light by the carbon dioxid given off by baking powder, or through the action of sour milk on soda, the gluten deficiency of the corn is made up for by the use of eggs, which hold the air bubbles which make it light. In breads of the third class, those raised by the carbon dioxid given off by the yeast, the gluten deficiency in the corn is supplied by the addition of some other flour, usually wheat or rye. Yeast-raised corn breads do not dry out nearly so quickly as the other types and they are palatable either warm or cold. For these reasons they are convenient for the housekeeper who does not wish to make bread fresh for each meal.

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[1] U. S. Dept. Agr., Office Secretary Circ. 19.

[2] Orig. Commun. 8. Internat. Cong. Appl. Chem. [Washington and New York], 18 (1912), Sect. VIIIc, pp. 119–127.

In the pages which follow recipes are given for breads of each class. The simpler breads, like ash cake and hoecake, are very old types closely resembling the bread of primitive people, and such corn breads were made by the Indians. Though easy to prepare, they are nevertheless very palatable.

ASH CAKE.

1 quart corn meal.
2 teaspoons salt.
1 tablespoon lard or other shortening.
Boiling water.

Scald the meal; add the salt and shortening, and when the mixture is cool form it into oblong cakes, adding more water if necessary. Wrap the cakes in cabbage leaves, or place one cabbage leaf under the cakes and one over them, and cover them with hot ashes.

HOECAKE.

Hoecakes are made out of corn meal, water, and salt. They were originally baked before an open fire on a board which for convenience had a long handle attached to it. At present they are cooked slowly and on both sides on a well-greased griddle.

CORN DODGER.

The corn dodger is like the hoecake except it usually contains a small amount of butter or lard. The meal is scalded and when cool is formed into cakes and cooked in a hot oven.

CRACKLING BREAD.

1 quart corn meal.
1 pint cracklings.
2 teaspoons salt.
Boiling water.

Mix the corn meal and salt; pour over this mixture enough boiling water to moisten but not enough to make a mush. When the meal has cooled, work the cracklings into it with the fingers. Form the dough into cakes about 4 inches long, 2 inches wide, and 1 inch thick; bake for 30 minutes. This bread, because of its large percentage of fat, is eaten without butter, and should be served very hot.

"Cracklings," like "scraps," is a name given to the crisp, brown meat tissue left after lard is "tried out." Cracklings consist of connective tissue with a large amount of fat adhering to it. Much of the fat can be removed by pressure. This is best done by squeezing them in a thin cloth while they are still warm or after they have been reheated.

Crisp Corn-Meal Cake.

1 cup milk.
One-half cup white corn meal,
One-half teaspoon salt.

Mix the ingredients and heat slowly until the boiling point is reached. It is not necessary to stir. Spread on a shallow buttered pan to a depth of about one-fourth of an inch. Bake in a moderate oven until crisp.

Parched Corn-Meal Biscuits.

1 cup yellow corn meal.
2 teaspoons salt.
2 cups peanut cream.

Put the meal into a shallow pan and heat in the oven until it is a delicate brown, stirring frequently. Make the nut cream by mixing peanut butter with cold water and heating. It should be the consistency of thick cream. While the nut cream is hot, stir in the corn meal, which should also be hot. Beat thoroughly. The mixture should be of such consistency that it can be dropped from a spoon. Bake in small cakes on a greased pan.

If preferred, these biscuits may be made with cream or with butter in place of peanut cream, and chopped raisins may be added, 1 cup being the allowance for the quantities given above.

Beaten Corn Bread.

Three-fourths cup white corn meal.
Three-fourths cup wheat flour.
1 teaspoon sugar.
One-half teaspoon salt.
1 tablespoon lard.
Water.

Mix and sift the dry ingredients and rub the lard thoroughly into the mixture by means of a fork. Add a little water, enough to moisten the mixture throughout, but not too much, as it must be crumbly. Spread on a board and beat thoroughly with a rolling pin or mallet, as is done with beaten biscuits, folding it over frequently to introduce air. Roll out about one-half inch thick, cut into small pieces, and bake in a moderate oven. In camp this can be baked in a hot greased pan propped up before a hot fire.

Sour-Milk Corn Bread.

2 cups corn meal.
2 cups sour milk.
2 tablespoons butter.
2 tablespoons sugar, white or brown.
1½ teaspoons salt.
2 eggs.
1 teaspoon soda.
1 tablespoon cold water.

There are two ways of mixing this bread. By the first the meal, milk, salt, butter, and sugar are cooked in a double boiler for about 10 minutes. When the mixture is cool, the eggs are added well beaten and the soda dissolved in the water. By the other method all the dry ingredients, including the soda, are mixed together, and then the sour milk and eggs well beaten and the butter are added. If the second method is followed, the cold water is not needed. The bread should be baked in a shallow iron or granite pan for about 30 minutes.

Since the bread made by the first method is of much better texture, that method is to be preferred, except in cases where there is not time for the necessary heating and cooling of the meal.

Buttermilk may be substituted for the sour milk, in which case the butter should be slightly increased; or sour cream may be used and the butter omitted.

Spider Corn Bread.

1½ cups corn meal.
2 cups sour milk.
1 teaspoon soda.
1 teaspoon salt.
2 eggs.
2 tablespoons butter.

Mix the dry ingredients. Add the eggs well beaten and the milk. Place the butter in a frying pan, melt it, and grease the pan well. Heat the pan and turn in the mixture. Place in a hot oven and cook 20 minutes.

Zuñi Indian Bread.

1 cup white corn meal.
1 cup yellow corn meal.
1 cup water.
1 teaspoon salt.
One-eighth teaspoon cayenne.
1 cup chopped suet.

Mix all well together; form into rolls about 5 inches long; roll in greased paper; and bake in a moderate oven 1 hour. Serve hot.

The habit among the Indians was to roll these cakes in the husks of the corn, a method which is sometimes followed by campers.

Corn-Meal Muffins.

One-half cup corn meal.
1 cup flour.
3 teaspoons baking powder.
2 tablespoons sugar.
1 tablespoon melted butter.
1 teaspoon salt.
Three-fourths cup milk.
1 egg.

Mix and sift the dry ingredients; add the milk gradually, the egg well beaten, and the melted butter; bake in a hot oven in buttered gem pans 25 minutes.

Corn Muffins with Dates.

1 cup white corn meal.
2 tablespoons brown sugar.
1 teaspoon salt.
2 tablespoons butter.
1¼ cups milk.
1 cup wheat flour.
4 teaspoons baking powder.
1 egg.
One-half cup dates cut into small pieces.

Cook together the first 5 ingredients for 10 minutes in a double boiler. When cool, add the eggs, the dates, and the flour sifted with the baking powder. Beat thoroughly and bake in muffin pans in a quick oven, or bake in a loaf. The bread will keep in good condition longer if the dates are cooked with the corn meal and other ingredients in the double boiler.

Custard Corn Cake.

2 eggs.
One-fourth cup sugar.
1 teaspoon soda.
1 teaspoon salt.
1 cup sour milk.
1 cup sweet milk.
1⅔ cups corn meal.
One-third cup wheat flour.
2 tablespoons butter.
1 cup cream.

Beat the eggs and sugar together thoroughly. Sift the flour, soda, and salt together and mix with the meal. Mix all the ingredients but the cream and butter. Melt the butter in a deep pan, using plenty on the sides. Pour in the batter, add (without stirring) a cup of cream, and bake 20 to 30 minutes.

When cooked there should be a layer of custard on top of the cake or small bits of custard distributed through it.

Corn-Meal Rolls.

1¼ cups wheat flour.
Three-fourths cup corn meal.
3 teaspoons baking powder.
2 tablespoons butter.
1 egg.
One-half cup milk.
1 teaspoon salt.

Sift together the flour, baking powder, and salt, and mix with the meal. Rub the butter into the dry ingredients. Beat the egg, add the milk, and add this mixture to the dry ingredients. Add more milk if necessary to make a soft dough. Roll out on a floured board, handling lightly. Cut with a round biscuit cutter, fold like Parker House rolls, and bake in a quick oven.

Soft Corn Bread.

Two-thirds cup rice.
One-half cup white corn meal.
3 cups milk or milk and water mixed.
2 or 3 eggs.
2 tablespoons butter.
1 teaspoon salt.

Mix the rice, meal, and salt with the milk in the top of a double boiler, and cook until the rice is nearly soft. Add the butter and the eggs well beaten and transfer to a greased granite baking pan. Bake in a moderate oven for an hour. Serve in the dish in which it is baked.

Spoon Corn Bread.

2 cups water.
1 cup milk.
1 cup white corn meal.
1 tablespoon butter.
2 eggs.
2 teaspoons salt.

Mix the water and the corn meal and bring slowly to the boiling point and cook 5 minutes. Add the eggs well beaten and the other ingredients. Beat thoroughly and bake in a well-greased pan for 25 minutes in a hot oven. Serve from the same dish with a spoon.

Delicate Spoon Corn Bread.

One-fourth cup corn meal.
1 teaspoon butter.
1 tablespoon sugar.
1 teaspoon salt.
2 eggs.
2 cups milk.

Mix the corn meal and water and bring slowly to the boiling point and cook a few minutes. Add the butter, sugar, salt, and yolks of eggs. Lastly, fold in the whites of eggs beaten stiff. Bake in a hot oven 30 minutes. Serve in the dish in which it is cooked.

Corn Meal and Hominy Bread.

1 cup cooked hominy.
1 cup milk.
1 tablespoon melted butter.
1 cup white corn meal.
2 eggs.
1½ teaspoons salt.

Mix the ingredients and bake 30 minutes in a moderate oven.

Steamed Corn-Meal Bread.

2 cups yellow meal.
1 cup flour.
2¼ cups sour milk.
1½ teaspoons soda.
1 teaspoon salt.
One-half cup molasses.

Sift together the flour, soda, and salt, and stir in the corn meal, mixing thoroughly. Add the molasses and sour milk. Pour into a well-buttered mold, which should not be more than two-thirds full. A lard pail is a good substitute for the mold. Cover closely and steam 5 hours.

BOSTON BROWN BREAD.

1 cup corn meal.
1 cup rye meal.
1 cup Graham flour.
2½ teaspoons soda.
1 teaspoon salt.
Three-fourths cup molasses.
2 cups sour milk, or
1¾ cups sweet milk.

Mix and sift the dry ingredients and add the molasses and milk. Beat thoroughly and steam 3½ hours in well-buttered, covered molds. Remove the covers and bake the bread long enough to dry the top.

This may be made also with 1½ cups corn meal and rye meal and no Graham flour.

BOSTON BROWN BREAD WITH FRUIT.

Follow recipe for Boston brown bread, adding to the dry ingredients a cup of seeded and shredded raisins or prunes or a cup of Zante currants.

BOSTON BROWN BREAD WITH CREAM.

1 cup rye meal.
1 cup corn meal.
1 teaspoon salt.
One-half cup molasses.
2 eggs.
1½ cups thin cream.

Sift the dry ingredients. Add molasses, yolks of eggs well beaten, and cream; lastly, fold in the whites of eggs beaten stiff. Pour mixture into buttered mold, steam 3 hours; then bake 1 hour in a moderate oven.

INDIAN MEAL BREAD.

1½ cups Graham flour.
1 cup corn meal.
One-half tablespoon soda.
1 teaspoon salt.
One-half cup molasses.
1¾ cups milk.

Mix and steam as Boston brown bread.

APPLE CORN BREAD.

2 cups white corn meal.
2 tablespoons sugar.
One-half teaspoon salt.
1 teaspoon soda.
1 teaspoon cream of tartar.
1¾ cups milk.
3 tart apples pared and sliced.

Mix the dry ingredients, add milk, and beat thoroughly. Add the apples. Pour into a well-buttered shallow pan and bake 30 minutes in hot oven.

SOUTH CAROLINA CORN BREAD.

1½ quarts fine corn meal.
2½ quarts wheat flour.
or
2½ quarts fine corn meal.
1½ quarts wheat flour.
2 teaspoons salt.
1 pint mashed sweet potatoes.
1 cake yeast.

Mix 1 pint each of the corn meal and the flour and add warm water enough to form a stiff batter. Add the yeast cake, mixed with a small amount of water. Keep this sponge in a warm place until it becomes light. Scald the meal with boiling water and as soon as it is cool enough add it to the sponge with the flour, potatoes, and salt. The dough should be just thick enough to knead without danger of its sticking to the board. Experience will teach how much water to use to secure this end. Knead well and put in a warm place to rise. When it is light, form into loaves, put into bread pans, and let it rise until its volume is doubled. Bake in a moderate oven.

It was a common, though not general, practice in New England to add cooked pumpkin to the other ingredients in making such bread as this, very much as sweet potato is used in the South. The sweet potato or pumpkin changes the flavor of the bread somewhat and apparently facilitates the rising of the dough, improves the texture of the bread, and tends to keep it moist. However, if sweet potato or pumpkin, either home cooked or canned, can not be conveniently obtained, good bread can be made without it.

Gluten and Corn Bread.

2¼ cups yellow or white corn meal.
Three-fourths cup gluten, rye, or wheat flour (preference being in order named).
1½ cups boiling water.
1 tablespoon sugar.
One-half yeast cake (or 1 cake, if haste is an object) dissolved in one-fourth cup lukewarm water.
2 tablespoons butter, lard, or a mixture of the two.
3 teaspoons salt.

Pour the corn meal into a dish of boiling water. It is not sufficient merely to pour the boiling water over the meal in a cold dish. If yellow meal is used, heat it a little in addition to pouring it into the boiling water, or mix meal and water and heat in a double boiler. When cool mix with the other ingredients and knead thoroughly. Place in a baking tin, and bake when risen sufficiently.

Third Bread.

2 quarts yellow corn meal.
2 teaspoons salt.
Boiling water.
One-half cup molasses.
1 quart rye flour
1 yeast cake.

Mix the corn meal and salt and pour over them enough boiling water to moisten the mixture but not to make a batter. When cool add the molasses and the yeast mixed with a little water. Add the rye flour to the corn-meal mixture, gradually alternating it, if necessary, with lukewarm water in order to keep the dough thin enough to be stirred with a spoon. Let it rise until light, form into a loaf, and bake in a slow oven four or five hours.

CORN-MEAL PUFFS, GRIDDLECAKES, AND WAFFLES.

The peculiar granular consistency of corn meal, which is a disadvantage under some circumstances, is an advantage in making griddlecakes or waffles, for it renders them very tender.

Corn-Meal Puffs.

1 quart milk.
Two-thirds cup corn meal.
One-fourth cup sugar.
1 teaspoon salt.
8 eggs.
Grated nutmeg (if desired).

Cook the milk and meal together 15 minutes with the salt and sugar. When cool add the eggs well beaten. Bake in cups. Serve with stewed fruit or jam.

CORN-MEAL FRITTERS.

By increasing the corn meal in the above recipe by half (i. e., to 1 cup) the batter is made stiff enough to be dropped into hot fat and fried.

CORN-MEAL PANCAKES.

2 cups flour.
One-half cup corn meal.
1½ tablespoons baking powder.
1½ teaspoons salt.
One-third cup sugar.
1½ cups boiling water.
1¼ cups milk.
1 egg.

Add meal to boiling water and boil 5 minutes; turn into bowl, add milk and remaining dry ingredients mixed and sifted, then the egg well beaten, and butter. Cook on a greased griddle.

CORN MEAL AND WHEAT WAFFLES.

1½ cups water.
One-half cup white corn meal.
1½ cups milk.
3 cups flour.
3 tablespoons sugar.
1¼ tablespoons baking powder.
1½ teaspoons salt.
Yolks 2 eggs.
Whites 2 eggs.
2 tablespoons melted butter.

Cook the meal in boiling water 20 minutes; add milk, dry ingredients mixed and sifted, yolks of eggs well beaten, butter and whites of eggs beaten stiff. Cook on a greased waffle iron.

CORN MEAL AND RICE WAFFLES.

One-half cup corn meal.
One-half cup flour.
1 cup boiled rice.
2 eggs well beaten.
1 tablespoon melted butter.
One-half teaspoon soda.
1 teaspoon salt.
1 cup sour milk.

Sift together the flour, soda, and salt. Add the other ingredients and beat thoroughly.

BUTTERMILK WAFFLES.

3 cups water.
2 cups corn meal.
2 cups wheat flour.
1 cup sweet milk.
4 eggs.
2 tablespoons butter.
2 teaspoons salt.
1½ teaspoons soda.
Buttermilk or sour milk enough to make a thin batter.

Cook the meal, water, salt, and butter together in a double boiler for 10 minutes. When the mush is cool add the eggs, beaten separately until very light. Sift the flour and soda together. Add the flour and the sweet milk alternately to the corn mixture. Finally add the buttermilk. This mixture is improved by standing a short time.

CORN-MEAL PUDDINGS.

There is a large variety of popular and very nutritious puddings made chiefly out of milk, to which a small amount of some starchy substance has been added. The substance most frequently used is probably rice, but corn meal too has always been commonly used.

The proportion of cereal to milk is always as low as 1 to 12, and sometimes as low as 1 to 16; i. e., one-fourth to one-third cup of cereal to 3 or 4 cups of milk. The only other ingredients are sugar or molasses and some flavoring material. Other puddings are made by combining corn meal with milk and eggs.

Indian Pudding.

5 cups milk.
One-third cup corn meal.
One-half cup molasses.
1 teaspoon salt.
1 teaspoon ginger.

Cook milk and meal in a double boiler 20 minutes; add molasses, salt, and ginger; pour into buttered pudding dish and bake 2 hours in slow oven; serve with cream.

Corn Meal and Fig Pudding.

1 cup corn meal.
1 cup molasses.
6 cups milk (or 4 of milk and 2 of cream).
1 cup finely chopped figs.
2 eggs.
1 teaspoon salt.

Cook the corn meal with 4 cups of the milk, add the figs and salt. When the mixture is cool, add the eggs well beaten. Pour into a buttered pudding dish and bake in a moderate oven for 3 hours or more. When partly cooked add the remainder of the milk without stirring the pudding.

Corn Meal and Apple Pudding.

For the figs in the above recipe substitute a pint of finely sliced or chopped sweet apples.

Boiled Corn Meal and Apple Dumpling.

6 tart apples, medium-sized.
1 teaspoon salt.
2 cups corn meal.
Boiling water.

Pour boiling water over the corn meal, to which the salt has been added, using enough water to make a thick paste; stir thoroughly; with the hands flatten out the paste until it is about 1 inch thick and wrap it around the apples, which have been pared, cored, and quartered. Inclose in a pudding cloth and cook in boiling salted water. If preferred, the pudding may be put in a bowl, covered with a plate, and steamed.

This is an old-fashioned dish which was commonly served as an accompaniment to roast pork.

This pudding may be used as a dessert by cutting it open before serving, scattering sugar and bits of butter over it and then a little cinnamon or grated nutmeg. Cream or any of the usual pudding sauces may be served with it if desired.

CORN-MEAL CAKES.

It is often possible to substitute corn meal for part of the flour in making cakes. In some of the cases given here, in making gingerbread, for example, there is no special advantage in using it, but it is well to know that it can be used in emergencies. In making doughnuts, however, there is a decided advantage in substituting corn meal for part of the flour, for doughnuts so made are much more likely to be tender than those made with wheat flour alone.

INDIAN-MEAL DOUGHNUTS.

Three-fourths cup milk.
1½ cups very fine white corn meal.
1¼ cups wheat flour.
One-fourth cup butter.
Three-fourths cup sugar.
2 eggs well beaten.
1 teaspoon cinnamon.
2 teaspoons baking powder.
1 level teaspoon salt.

Put milk and meal into a double boiler and heat together for about 10 minutes. Add the butter and sugar to the meal. Sift together the wheat flour, baking powder, cinnamon, and salt. Add these and the eggs to the meal. Roll out on a well-floured board; cut into the desired shapes; fry in deep fat; drain and roll in powdered sugar.

MOLASSES CORN CAKE.

2 cups yellow corn meal.
One-half cup molasses.
One-half cup sugar.
2 tablespoons butter.
1 teaspoon salt.
1 cup sour milk.
1 cup sweet milk.
1 cup wheat flour.
1½ teaspoons soda.
1 egg.

Mix the first seven ingredients in a double boiler and cook over hot water. Cook for about 10 minutes after the mixture has become hot. After it has cooled add the wheat flour and soda, thoroughly sifted together, and the egg well beaten. Bake in a shallow tin.

CORN-MEAL GINGERBREAD.

To the above recipe add one-half teaspoon ginger, 1 teaspoon cinnamon, and one-half teaspoon cloves, sifting them with the flour.

CORN-MEAL AND ORANGE GINGERBREAD.

To the recipe for gingerbread given above add the grated rind of an orange or one-half cup of orange marmalade. If the latter is added, the amount of milk and of sugar should both be slightly reduced.

FRUIT GEMS.

1 cup corn meal.
1 cup milk.
1 teaspoon salt.
1 teaspoon baking powder.
One-half cup raisins.
One-half cup Zante currants.
One-half cup cream.

Cook the meal and salt in the milk for a few minutes. When cool add the baking powder and beat thoroughly. Add the fruit and cream and bake in well-buttered muffin tins.

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U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

566

Contributions from the Bureau of Animal Industry, A. D. Melvin, Chief, and the Bureau of Plant Industry, Wm. A. Taylor, Chief. December 31, 1913.

BOYS' PIG CLUBS,

WITH SPECIAL REFERENCE TO THEIR ORGANIZATION IN THE SOUTH.

By W. F. Ward,

Senior Animal Husbandman, Animal Husbandry Division, Bureau of Animal Industry.

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INTRODUCTION.

The southern people are great consumers of pork in its many forms, but are comparatively small producers of this commodity. There are millions of dollars spent every year for pork to use on the farms of the South, while producing a cotton crop. Nor is anything like all of this meat bought for the negro laborers on these plantations, for the number of farms that raise and cure all of the meat to be consumed is indeed very few. The experiment stations have shown beyond a doubt that hogs can be raised and fattened cheaper throughout this section than in any other portion of the United States. The hogs are subject to no more diseases nor drawbacks of any other character than are hogs in the corn belt; the climate is such that high-priced hog houses are not required for the

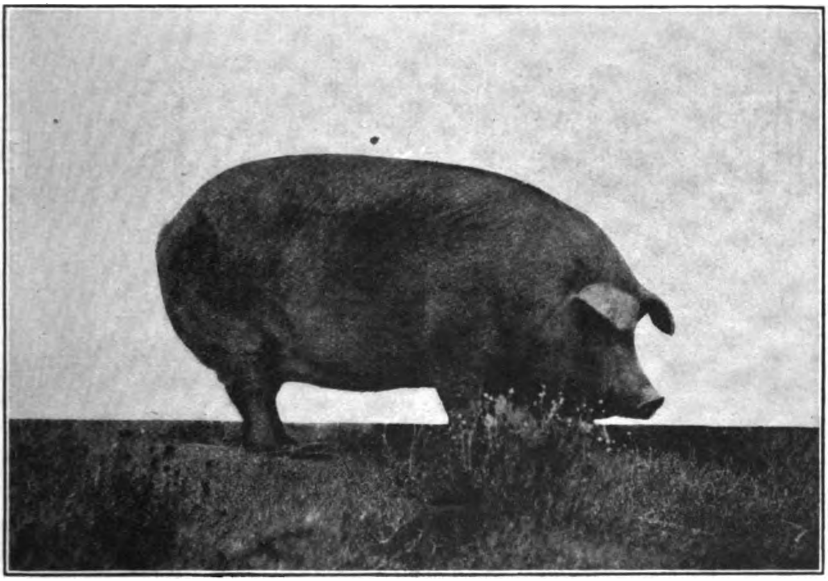

Fig. 1.—The sweepstakes champion at the Louisiana State fair in 1912, raised by a member of the boys' pig club. Weight 500 pounds at 12 months of age. This is the type of hog all boys should try to raise.

where points of interest concerning the club work and breeding or feeding topics may be discussed and questions answered. The county demonstration agent should be notified of these meetings, so that he may attend if possible.

RULES FOR THE CLUB.

Each club should elect three officers—a president or manager, a vice president, and a secretary-treasurer. A simple constitution and by-laws should be adopted, and these may be patterned after the sample given in the appendix at the end of this circular. The president of the county club should be the county superintendent of education, or some earnest teacher or other influential citizen who will take active interest in the work, especially in forming district clubs, soliciting prizes, etc., for the winners at the county exhibit, and encouraging and aiding the boys in any other way possible.

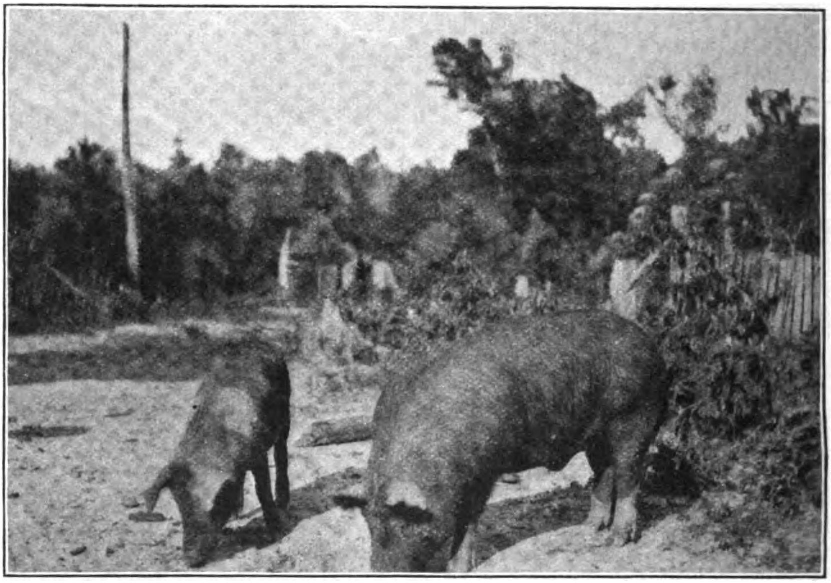

FIG. 2.—The large hog on the right was raised by a pig-club boy, and is 6 months old. The small hog was raised by the father and is 2 years old. Who is the better hog raiser?

The president of the district club should be some person who will encourage and push the work, such as the teacher of agriculture in the local school. He should see that the members follow the rules of the club and he should collect their reports and forward them promptly to the president of the county club, who will send them to the State agent.

The duty of the vice president should be to perform the duties of the president in his absence.

The secretary-treasurer should keep a record of the meetings of the club, and render a report of the same at the annual meeting. He should act as correspondent of the club in such matters as pertain to the business of it and do all in his power to promote the interests of the club.

The following rules should be adopted by each club:

1. Any boy between the ages of 10 and 18 years may become a member.
2. Each boy must secure at least one pig if he becomes a member of the club.
3. Each member must care for his stock in person, and keep a record of the feed given and the pasture grazed. He must record the weight of each pig when it came into his possession and at stated intervals, so as to determine the gains. The date of farrowing should also be recorded.
4. Record blanks, which will be furnished, should be filled out and certified by two disinterested persons.
5. Each member must have owned and kept a record of his pig for at least four months in order to compete for a prize.
6. The members of the club must agree to study the instructions of the United States Department of Agriculture.
7. Each member must, whenever possible, show at least one pig at the county exhibit, and the winners of the county exhibit must show their pigs at the State fair.

PRIZES AND AWARDS.

It will be found best to distribute the prizes into several classes, in order that a number of contestants may have a chance to win a prize. Honor and recognition sometimes count for more than money. Badges, certificates, and diplomas given to the club members are often appreciated as much, if not more, than money and other expensive premiums. When liberal amounts are given for prizes in a county it will be well to give prizes to the winners of the district clubs and offer premiums to the club that will make the highest records with five to a team, dividing this premium into several awards, depending upon the rank.

The prizes given should be appropriate and such as would add interest to the work. They may be a trip to the State fair, a visit to Washington, a trip to the feeders' and breeders' show at Fort Worth or to the International Live Stock Exposition at Chicago, scholarships in agricultural schools, the expenses necessary to take a short course at the State agricultural college, purebred pigs, purebred chickens, farm tools, or books on live stock, etc., as well as cash prizes.

The following is a list of some of the exhibits for which prizes may be offered:

Class 1. Prizes for the members making the best exhibit, the results to rest upon the following basis:

	Per cent.
(*a*) The best hog with respect to the purpose which it is to serve	40
(*b*) The greatest daily gains on the hog	15
(*c*) Cheapest cost of production	25
(*d*) Best-kept records of the feeding and care of the pig	20

Sow and pigs may be considered.

Class 2. Best pig for slaughter purposes, either grade or purebred. Boars not eligible to compete in this class.

Class 3. Best boar for breeding purposes—purebred only.

Class 4. Best brood sow for producing hogs desirable for market purposes, taking into consideration her conformation and the number and vitality of the pigs farrowed. Either purebred or grade eligible.

FORAGE CROPS.

The buying of high-priced commercial feeds on which to grow or fatten the hogs is not desirable, but the boys should be encouraged in every way possible to plant some hog crops which may be grazed off. Information concerning the growing and grazing of these crops can be secured from Farmers' Bulletin 411.

The money derived from the sale of the fattened hogs can often be profitably used for preparing hog crops the following year or for inclosing a permanent pasture for the hogs. Parents should always encourage the boys by paying them a fair price for their fat hogs when they are used for home consumption.

PASTURING A CLUB PIG WITH OTHERS.

If it is desired to keep the pig in the same pasture with other hogs, the acreage of the pasture and the number and approximate weights of all the hogs on the pasture should be recorded at the beginning and the end of the pasture season. The amount of pasture used by the boy's pig can then be estimated. If this method is followed the boy should make a small pen in a convenient place in the pasture, so that he can feed his hog separate from the rest. In figure 4 is shown such a pen. If it can be built under a tree to furnish shade, so much the better. It need not be over 8 feet square and should have a sliding door, which may be raised to let the pig enter and immediately dropped to keep out other hogs. The pig can be let out again as soon as he has consumed his feed. If the other hogs in the pasture are to receive feed, too, the boy's pig should be fed in his pen first in order that he will not get feed which would not be charged against him. If a number of holes are bored in the door, it can be held with a peg at any height to let pigs enter in case the boy wants to use the same pen in feeding small pigs separate from

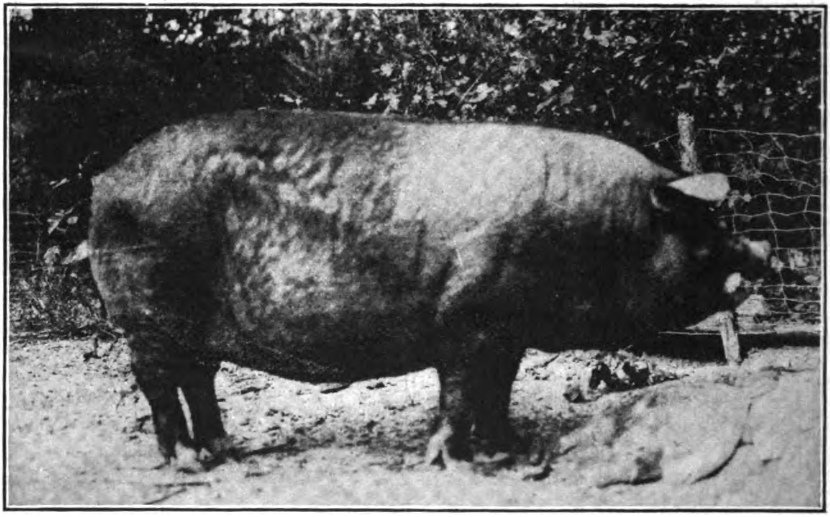

FIG. 5.—Hog raised by a pig-club boy in Alabama.

their mother. In this case the pigs can be given feed in the pen first, the door dropped, and the sow fed on the outside, or she may be fed in the pen after the pigs have eaten.

PASTURING WITHOUT FENCES.

It is not necessary that the land on which a boy plants his hog crops be fenced off to itself if he has but one or two pigs, for he can easily construct a pen from hurdles made of light 1 by 3 inch material or woven wire, which can be easily moved to permit the hog to graze the crop. A light cover can be made to fit upon one corner of the pen to furnish shade for the pig during the day. Full information concerning these things can be secured from the State agent of the pig-club work.

DISEASES.

SCOURS.

If the pigs show indications of scouring, keep the charcoal mixture mentioned later where the sow can eat it at will, or give her 15 grains of copperas in her slop every night and morning until effective. In cases of severe scouring with little pigs each may be given 5 to 10 grains of subnitrate of bismuth after changing the sow's feed and giving her the copperas.

If hogs get plenty of exercise and are fed slop or soft feeds, they will seldom become constipated. In case a pregnant sow becomes very constipated give her one-fourth of a pound of Epsom salt in her slop once daily until her bowels become normal.

WORMS.

The cause of the greatest loss of hogs in the South is worms. One of the best preventive measures is to keep a mixture of charcoal, ashes, lime, salt, sulphur, and copperas where the hogs can eat it at will. It may be made up in the following proportions:

Charcoal mixture.

Charcoal	bushel	1	Air-slaked lime	pounds	8
Hardwood ashes	do	1	Sulphur	do	4
Salt	pounds	8	Pulverized copperas	do	2

Mix the lime, salt, and sulphur thoroughly and then mix with the charcoal and ashes. Dissolve the copperas in 2 parts of hot water and sprinkle over the whole mass, mixing it thoroughly. Store this in a barrel under shelter, but keep some of it in a shallow box for the hogs at all times.

If hogs are already wormy, turpentine can be given in the slop each morning for three mornings, at the rate of one teaspoonful for each 80 pounds of live weight. Also give the hogs the charcoal mixture.

LICE.

Examine the hogs frequently about the ears, neck, flank, and the inside of the legs to see if they are lousy. Lice cause unthriftiness among hogs of any age and death among many pigs. To get rid of them, wash or dip the hogs in a solution of any of the coal-tar disin-

on one side, to which the floor is nailed. A large hole can be bored through the front end of the outer skids so that a chain can be fastened to them to facilitate moving the house by the use of a team. A piece of 2 by 4 inch material is nailed on the outer edges of the top of floor to prevent the house from spreading at the bottom.

Each side of the house is made of 6 pieces of 1 by 12 inch plank 8 feet long, nailed to a piece of 2 by 4 lying flat about 9 inches from the top of the plank, another about 3½ feet from the top, and a piece of 2 by 8 nailed edgewise about 11 inches from the bottom. This should be braced at each end of the underside by a right-angle block of 2 by 8 inch material nailed to the rail and to the side of the house. The long piece of 2 by 8 will act as a guard under which the young pigs may take shelter when the sow lies down. This will save many pigs from being crushed to death.

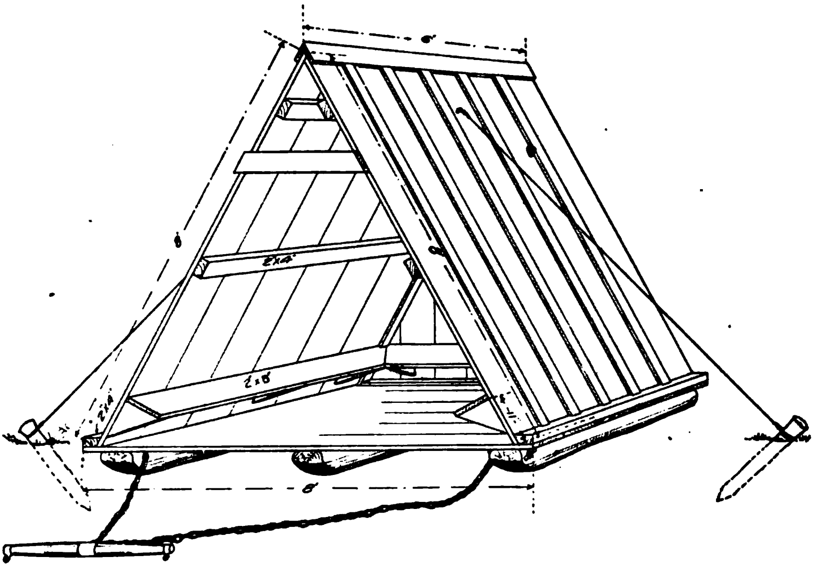

FIG. 7.—A portable A-shaped hog house, with chain and singletree for hauling.

The back of the house fits between the two sides in a groove made by nailing two pieces of 1 by 1½ inch material lengthwise on the inner side of each side of the house. The house is then "set up" on the floor and the sides held together by nailing a short piece of 1 by 6 inch plank across the front and back of the house about 1½ feet below the top. This will prevent it from being blown down by the wind or a storm. A saddle board made by nailing two pieces of 1 by 6 inch plank together can then be put over the ridge of the house to keep out rain.

A house built thus can be moved on the skids or can be taken down by removing the 1 by 6 inch brace from the front and the back of the house. If the house is located in an open field where there is danger of heavy winds, a guy wire should be securely fastened in each side of the house near the top and fastened to a stake driven deep into the ground. This is a precaution which will justify the trouble required, as it may save a litter of pigs from being crushed in case of a storm. Such a house can be constructed without the "take-down" feature, and by securely nailing it will not need the guy wire. Some dirt may be thrown up at the front of the house to the level of the floor so that young pigs may enter without trouble.

The material necessary to build this house is as follows:

13 pieces 1 by 12 inch by 16 feet for sides, back, and floor of house.
9 pieces 16-feet batten.
3 pieces 2 by 4 inch by 12 feet for framework.
2 pieces 2 by 8 inch by 12 feet for pig rail or guard.
1 piece 1 by 6 inch by 16 feet for saddle board.
3 poles for skids.
Nails.

Total, 272 board feet of lumber, 144 linear feet of batten, 3 poles, and the nails. As rough lumber suitable for the construction of such a house can usually be secured for about $12 per 1,000 in the South, the material will cost about $5.

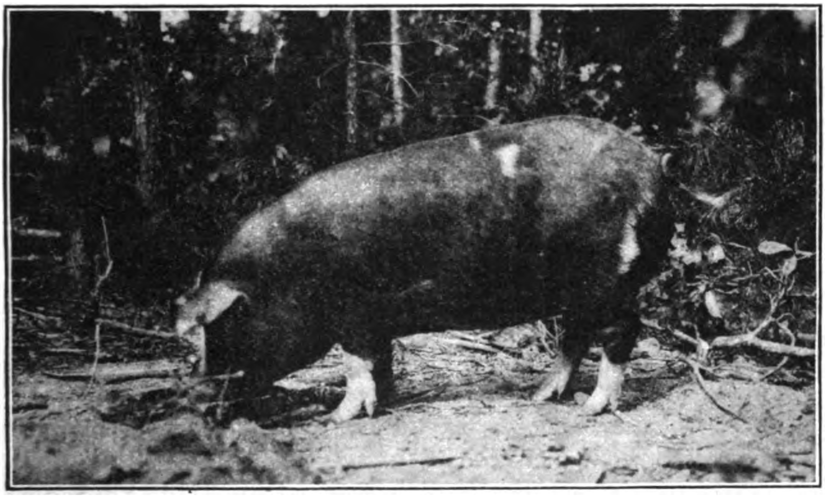

FIG. 8.—Hog raised by a pig-club boy in Alabama.

This type of house is suitable for practically all parts of the South, as no extremely cold weather is experienced and the open front permits sunshine to enter the house for several hours each day.

HOG SHELTERS.

In case a boy can not obtain material to build such a house as has just been described, he should get whatever material is available on the farm and build a shelter for his hogs. It can be made out of waste planks, for any shelter that will protect the hogs from cold winds and rain and give them a dry bed, at the same time permitting the sun to shine in during a portion of the day, will be quite an improvement over conditions existing on so many farms at present.

A shelter to be used during the summer months may be made by setting four poles or posts into the ground and securely nailing 2 by 6 inch material around these about 3 feet from the ground; upon

SECTION 5.—*Secretary-Treasurer.*

The secretary-treasurer shall keep a record of all proceedings of the association, and shall render a report of the same at the annual meeting: shall act as correspondent in matters pertaining to the business of the association, and shall keep a correct enrollment of all members.

SECTION 6.—*Order of business.*

Reading of the minutes of the previous meeting.
Report of the secretary-treasurer.
Reports of committees.
Unfinished business.
New business.
Election of officers.

(Correspondence should be addressed to W. F. Ward, in charge of beef-cattle investigations and pig clubs, Bureau of Animal Industry, or to Bradford Knapp, in charge of farmers' cooperative demonstration work, Bureau of Plant Industry, according to the information desired.)

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SUGAR-BEET GROWING UNDER IRRIGATION.

UNIVERSITY OF VIRGINIA GENERAL LIBRARY 679

By C. O. Townsend,
Pathologist, Cotton and Truck Disease and Sugar-Plant Investigations.

INTRODUCTION.

The present sugar-beet belt of the United States, that is, the area within which the soil and climatic conditions admit of the successful production of sugar beets for the manufacture of sugar, extends entirely across the northern portion of this country. The present southern boundary of this area is a somewhat indefinite and irregular line that may be said to extend from Virginia on the east to the southern part of California on the west. Efforts are being made to extend this line farther south, thereby increasing the productive sugar-beet area. This can undoubtedly be accomplished with an increased knowledge of the requirements of the sugar-beet plant combined with its wide range of adaptability. As it is at present this belt is capable of maintaining hundreds of sugar-beet mills, the output of which would supply this country with the millions of pounds of sugar required for home consumption. A study of the great variety of soil and climatic conditions under which sugar beets thrive illustrates and emphasizes the wonderful adaptability of this remarkable plant to the wide range of conditions under which it may profitably be produced.

This bulletin will be confined to a consideration of the conditions and cultural methods employed in those areas where there is an insufficient precipitation for the profitable production of sugar beets, namely, the central, western, and southwestern portions of the United States. The area of insufficient rainfall is separated from the area of abundant rainfall not by a distinct line but by a zone varying in width, irregular in outline, and shifting now east, now west, with the seasonal changes in climatic conditions.

SELECTION OF SOIL.

In the irrigated portion of the sugar-beet belt there is a great variety of soils, varying from the distinctly sandy type through the sandy and clay loams, the silt, and volcanic ash to the heavy black adobe.

In the selection of soil for sugar-beet culture it is safe to say that any of the soil types that are capable of producing good crops of other kinds will produce satisfactory beets.

The principal factors to be considered are the physical condition of the soil, the way in which it has been previously handled, and the climatic conditions. Much more depends upon these factors than upon the kind or type of soil to be used. The physical condition of the soil depends to a considerable extent upon the previous crops and the way in which the soil has been handled. The soil should be well supplied with humus, not only to insure its fertility but to improve its water-holding capacity. The previous cropping should have been such that the ground is in good tilth and reasonably free from pests that are capable of injuring sugar beets. The soil should be well drained, either naturally or artificially, in order to prevent water-logging, and the ground should be kept sweet and at the same time free from an excess of alkali. Most of the western soils are well supplied with lime, but an occasional application will in some cases be found beneficial.

Extremely sandy soils should not be selected for sugar-beet growing, especially in localities where high winds prevail in the spring. The shifting sands are liable to cut off the young plants or to cover and smother them. The adobe and silty soils should be handled with considerable care to prevent baking and crusting, but this is entirely possible, and when properly handled they are excellent soils for beet production. It is generally assumed that new sod ground is not suitable, for beets, but experience has shown that good results may be obtained from our western virgin soils. If such ground is to be planted to beets the sod should be broken in the summer, the ground fall plowed, worked down, and kept moist so that the sod will rot.

The kind and location of the subsoil are always important factors in selecting soil for sugar beets. In some cases the subsoil is very porous, so that the water passes rapidly through it with a tendency to leave the surface soil deficient in water and to leach out the plant foods. This condition can be relieved to some extent by increasing the humus supply in the soil and by giving special attention to firming the seed and root beds in order that their water-holding capacity may be increased. If the subsoil is extremely porous and deep, so that sufficient water can be retained in the root bed only with difficulty, it would not be advisable to use the soil for beet culture.

The opposite condition, namely, a very hard subsoil, known as "hardpan," prevails in certain localities. If the hardpan is close to the surface, so that there is not sufficient depth of soil to produce sugar beets, the field should not be used for this crop. If a good soil to the depth of 18 inches or more covers the hardpan, it will be safe to plant beets, provided the climatic conditions are favorable.

Between these extremes of subsoil conditions are found all gradations of porosity and hardness, each of which should be carefully considered in selecting soil for beets.

Soil conditions that would be favorable for sugar-beet culture in one locality might not be satisfactory in another locality on account of the climatic conditions. For example, in some localities a soil containing considerable sand might give excellent results with beets, while a similar soil in a locality where high winds prevail at planting time or shortly thereafter might make it very difficult to get and to maintain a profitable stand. It is apparent, therefore, that in the selection of soil for sugar beets and likewise for other crops one should have a fair knowledge of the soil, the subsoil, and the climatic conditions. It should be remembered, however, that many of the apparent difficulties may be in a large measure overcome by the exercise of proper foresight and care in preparing the soil and in the subsequent care of the beets.

CLIMATIC CONDITIONS.

The principal climatic factors which have a direct bearing upon sugar-beet culture are temperature, precipitation, and winds. Both high and low temperatures have a direct bearing upon the growth or quality of the beets. A study of the most successful sugar-beet localities of the world leads to the conclusion that beets of the best quality can not be grown where the average temperature for the growing season is much above 70° F. This does not mean that sugar beets can not be successfully grown in warm countries or in warm sections of a country, but it does mean that in such localities beets should be produced during the cooler portion of the year, which is now done successfully in certain portions of our own country. It is possible that beets adapted to higher temperatures may be produced by selection and breeding, and in this way the present large sugar-beet territory in the United States may be greatly increased.

Low temperatures are most likely to be injurious to sugar beets when the plantlets are just breaking through the ground. At this period the young plants are very tender and susceptible to injury by frost, but after the roots are established in the soil they rapidly become hardy and resistant to frost to a marked degree. Since the time of killing frosts varies from year to year in the same territory it is not always possible to avoid injury from this cause. A killing frost when the beets are coming up does not destroy the chance for a successful beet crop, but it often necessitates the expense and labor of replanting. It is therefore wise to delay the planting until the ground is warm and the growing conditions are otherwise favorable, since such conditions will rapidly push the beets beyond the period of frost injury. When the beets are mature they will stand a severe freeze without injury. The great danger from low temperatures at the end of the growing season is that the beets may be frozen in the ground, making the harvesting of the crop difficult or even impossible. To avoid this danger and the consequent loss that might result from such a condition it is advisable to get the beets out of the ground as soon as possible after they are ripe and to cover them to avoid freezing or drying. Apparently beet roots are not injured for sugar-making purposes by freezing, provided that they freeze and remain frozen until they are put through the mill, but alternate freezing and thawing causes them to decay and blacken, so that their value for sugar making is materially decreased.

The amount of precipitation, the time and manner in which the moisture falls, and the accompanying soil and weather conditions all have a direct bearing upon crop production. It is a well-known fact that a given amount of rainfall in a given locality may be ample for good crop production, while the same amount of rainfall in another locality may be entirely too small for satisfactory plant growth; and, indeed, in any locality a certain amount of rainfall may produce good crops in some fields and very poor crops in others.

Much depends upon the condition of the soil as to whether or not it is able to receive and retain the moisture. A large number of showers may show several inches of rainfall in the aggregate, and yet they may have accomplished little, if any, good so far as crop production is concerned, because they failed to moisten the ground to a sufficient depth. On the other hand, one or more heavy, dashing rains may show a satisfactory total rainfall for the season and at the same time be entirely unsatisfactory from the standpoint of crop production. Indeed, such rains may be more injurious than beneficial, because of packing and crusting the ground. A record of the total rainfall for a season, or even month by month, is of little value unless we know the nature and amount of each precipitation. The point of most vital importance is to have the ground in condition to receive as much as possible of the moisture that falls upon it and then to make every effort to retain that moisture in the soil.

The practice that prevails in some localities of letting the natural moisture escape from the soil, with the idea that more water can be applied when it is needed, is most pernicious and should not be followed. The moisture that falls upon the ground in the form of precipitation and is received and retained by the soil acts upon the plant foods day after day and week after week and accomplishes most for plant growth. There is a feeling of safety in having an unlimited supply of water for irrigation purposes, but it should be remembered that irrigation costs money and labor; precipitation is nature's gift.

Winds have been briefly mentioned in connection with soil selection for sugar beets, but they have a still wider bearing upon crop conditions. Not only do high winds have a tendency to destroy young beets and other plants by cutting and burying them with shifting sands, but they have a marked influence upon the amount of evaporation from the soil. For this reason a given amount of moisture in a locality where hot, dry winds prevail during the spring is much less effective in crop production than would be the same amount of moisture in a locality where such winds do not prevail, other conditions being the same. However, the injurious effects of winds may be overcome to a great extent by the use of proper cultural methods. For example, both the blowing of the soil and the excessive evaporation may often be reduced to the point of successful crop production by keeping the surface of the ground covered with a lump mulch. The mulch retards the evaporation, while its lumpy condition reduces the shifting of the soil. The cutting action of the shifting sand may be controlled by planting the beet rows at right angles to the direction of the prevailing winds when practicable and by attaching irrigating shovels to the drills, so that ridges capable of protecting the young plants will be thrown up between the rows at planting time. It is true that the slope of the land and the consequent direction of irrigation must also be considered in planting the beets, but whenever practicable the rows should be at right angles to the direction of the prevailing winds.

PLOWING.

The time, the depth, and the kind of plowing done and the condition of the ground at the time of plowing are all important factors in preparing the soil for sugar beets. Aside from the fact that each crop grown should in a way be a preparation for the crops that are to follow, the actual preparation of the ground should begin immediately after the preceding crop is removed. At this time the ground should be disked or harrowed, depending upon the condition of the soil, in order that a mulch may be formed for the retention of the moisture and that the plowing may be better done. The time of plowing in actual practice varies from early fall to late spring. As a rule, the most satisfactory time to plow for beets is in the fall, for the reason that fall-plowed ground is in better condition to receive the winter moisture and consequently to respond to the freezing and thawing action which tends to put the soil in the best physical and chemical condition for plant production.

Some growers object to plowing in the fall because of the fear that the ground will blow during the winter. If, however, the ground is left rough, the injury from blowing will be slight as compared with the advantages mentioned. If plowing in the fall is not practicable, the next best time is during the winter, if conditions will permit. In the irrigated sections plowing should never be left until spring if it can possibly be done earlier. In the first place the rush of spring work is not favorable to the best kind of plowing, but more important is the fact that stirring the ground to such a depth so close to planting time promotes evaporation and often the entire seed and root beds are comparatively dry before the seed is planted.

If done in the fall, there is very little danger of plowing too deep. Other things being equal, plowing to a depth of 10 to 14 inches or more will give the best results. Deep fall plowing not only furnishes a large storage space for winter moisture, but it enables the moisture to get well down below the surface in sufficient quantity so that the beet roots tend to grow to a good length, thereby increasing the tonnage. If for any reason the plowing is not done until spring it is not advisable to plow as deep as in the fall, since too much raw soil, not acted upon by the winter elements, would be thrown to the surface. Furthermore, it would be difficult to form the root bed properly if plowed too deep, a condition which would be more injurious than the more shallow plowing. Subsoil plowing is not generally practiced, and in cases where deep plowing is done and the soil below the plowed area is not too hard for the beet roots to penetrate it readily subsoiling would not pay for the labor and money expended. Where for any reason the plowing can not be done to the desired depth and the underlying soil is hard, it will pay to run the subsoil plow.

In plowing, the furrows should be as uniform as possible in regard to both width and depth. This applies not only to each furrow throughout its length, but also to one furrow as compared to another. If the ground is disked or harrowed before plowing and the furrows uniformly turned, the foundation for good seed and root beds is well established, provided the ground was in proper condition from the standpoint of moisture when plowed. Ground is in proper condition for plowing when it is neither too wet nor too dry. Under no circumstances should ground be plowed when wet, since plowing under such circumstances injures the physical condition of the soil to an extent that often requires years to correct. Plowing should always be done when the ground is in what is called a friable condition, that is, when it is capable of falling apart as the furrow is turned so that there are no air spaces below, as is the case when the ground is too wet or when it is dry and cloddy. Good plowing when the soil is right physically is the only condition that will insure the making of good seed and root beds.

THE SEED AND ROOT BEDS.

The preparation of the ground after plowing consists in those operations which put the soil in the best possible condition to germinate the seed and produce the crop. These operations will depend upon the time of plowing, the condition of the soil, and the climatic conditions. The seed requires a uniformly fine, firm, moist bed in order to produce a quick and uniform germination, which is especialy desirable in beet culture. The more quickly the seeds germinate, the more certain is a good stand, which is the first requirement of a satisfactory crop. A uniform germination is desirable, because if the plants all start at once each plantlet helps others to get through to the light, and the plants will then be of nearly uniform size when ready to thin. The plants require a fine, firm, moist, well-aerated root bed in order to make a satisfactory growth. The root bed must be fine and firm because the plants must be held firmly in place during their entire period of growth, and the soil particles must be closely in contact with the feeding rootlets. The soil must be moist enough to supply the plants with mineral food in solution and with enough water to promote constant and rapid growth.

At the same time there must not be in the soil for any considerable period of time so much water that a free interchange of soil gases can not take place. If the gases produced in the soil can not escape and if an insufficient supply of air reaches the roots, the plant suffers and retarded growth results. The success with which the soil is put into the desired condition to meet these requirements controls in a large measure the resulting crop. If the ground is properly plowed in the fall when its physical condition is right, the root bed will be fine and free from air spaces. The winter moisture will usually pack the fall-plowed ground, so that the root bed will be firm. In the absence of natural winter rain or snow, winter irrigation should be practiced; otherwise, two of the most important objects of fall plowing will be lost, namely, the firming of the seed and root beds and the changes in the soil due to freezing and thawing.

If the ground is not plowed until spring, the seed and root beds must be artificially packed. This can best be done with a subsurface packer, which should follow immediately behind the plow. The subsurface packer consists of a series of wheels with knife-edges that can be pressed into the freshly plowed ground, exerting pressure downward and laterally at the same time. These wheels should be of sufficient diameter and enough weight should be applied so that they will go down into the root bed; otherwise, the desired results will not be accomplished. The packer should be followed immediately by the harrow, in order to form the necessary mulch and to retain the moisture in the soil. This mulch should be maintained until planting time, when, if the seed bed is not sufficiently firm, the roller and harrow should be used until the proper degree of firmness is produced. Due regard should be given to the condition of the soil when these implements are used, so that the flocculent condition of the soil is not destroyed. The ground should be so firm before the seed is put into it that even the horses' feet make but little impression upon it. Too much emphasis can not be placed upon the importance of putting the ground in the right condition to receive the seed and to grow the crop, and every hour spent in properly preparing the seed and root beds will well repay the grower.

Another important point in preparing the ground for beets is to see that it is properly leveled. The high points should be worked down and the depressions filled. In some fields this will require considerable labor, but it will pay to do this work thoroughly before planting to beets. A properly leveled field can be irrigated much more quickly, and, furthermore, if not properly leveled there will be high spots where the beets suffer from lack of sufficient moisture and low spots where the plants are injured by too heavy watering. The results in such fields are invariably disappointing from the standpoint of yields. It frequently happens that a field can not be perfectly leveled in one season, since the dirt that is pulled into the depression settles after moisture is applied and it still remains somewhat uneven. For this reason it is often wise to grow less expensive crops than sugar beets, such as small grains, until the surface of the ground is sufficiently level to admit of uniform and easy irrigation before undertaking the production of sugar beets.

DRAINAGE.

At first thought, drainage in an irrigated section of the country might seem unnecessary, but experience has shown that under certain conditions the constant applications of water cause the soil to become water-logged. This is especially true where the surface soil is underlain with a soil stratum that is nearly level and impervious or nearly impervious to water. It is true that in many irrigated sections natural drainage is so nearly perfect that artificial drainage is not necessary. This may be due to the porosity or to the natural slope of the underlying stratum. However, in all cases where there is a tendency for the soil proper to become water-logged, artificial drainage should not be neglected. The water-logging of the soil under irrigation is detrimental to crop production, not only because of the accumulation of so much water in the soil that the required amount of air is excluded from the plant roots, but also because the alkali in the soil and water is carried to the surface of the soil and deposited when the water evaporates. Many of these alkalis when present in large quantities are injurious to plant growth to such an extent that fields formerly very productive have become nonproductive through the accumulation of these salts. On the other hand, areas that are nonproductive because of the presence of large quantities of alkali may be rendered very productive by properly draining the land and then washing out the excessive salts by means of irrigation. Figure 1 shows the effect upon beets of a lack of drainage.

There are two general systems of artificial drainage that may be used for carrying off the excess of water or for removing the excess of salts from the soil, namely, (1) the open ditch and (2) the blind ditch in which tile or a similar conducting channel is used to aid the flow of the water through the ground. The blind ditch is most often used, and while its initial cost is somewhat greater than that of the open ditch it is more economical in the end, since it still allows the use of the land and if properly constructed does not require the expenditure of time and labor necessitated by the open ditch to keep it in working order. The depth at which the tile should be laid and the distance between the lines of tile will depend upon the soil conditions. The tiles should be so deep that they will not be interfered with by deep plowing and so that the water table will be below the lower end of the beet roots. The lines of tile should be so close together that the whole of the desired area will be drained. There should be a gentle slope of each tile line toward its outlet, and the openings in the tiles should be large enough to dispose quickly of the excess water.

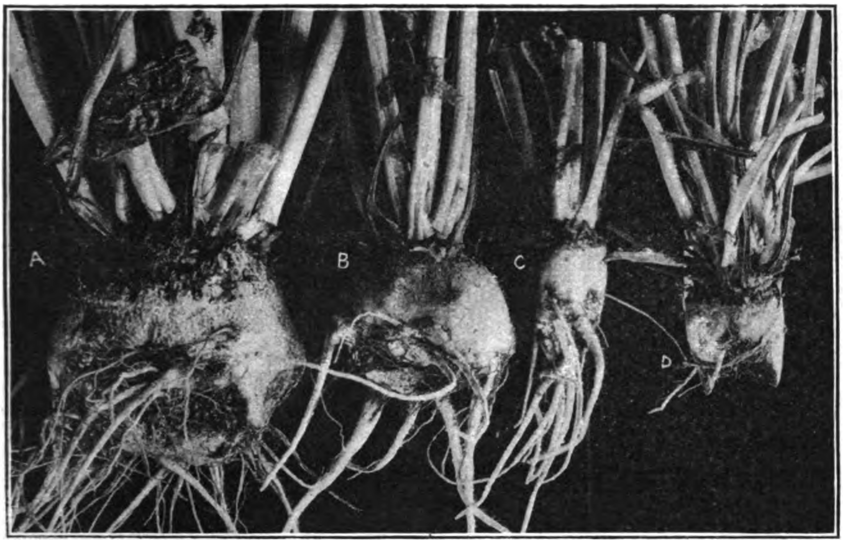

FIG. 1.—Sugar beets, showing the effect of water standing in the field, due to poor drainage.

IRRIGATION.

The proper use of irrigating water is one of the most important factors in the growing of sugar beets under irrigation. The time and method of application and the quantity of water used are the essential considerations in the irrigation of sugar beets. In all irrigated sections there is some precipitation in the form of rain or snow, although this precipitation is uncertain both as to time and amount. However, it should always be conserved and utilized to the fullest extent and the irrigating water should be looked upon as an insurance to carry the crop over periods of drought. In localities where winter precipitation is scarce, irrigation at that season is highly beneficial and should be practiced whenever possible, for reasons already indicated. It is usual in some localities to irrigate beets up; that is, the seed is planted in dry ground and the field is then flooded in order to germinate the seed. This is a poor practice and should be avoided whenever possible, especially in fields in which the soil has a tendency to form a crust. It is much more satisfactory to irrigate before planting if enough natural moisture can not be retained in the soil to produce germination.

In irrigating before germination it is generally best to corrugate the land, making the corrugations 5 or 6 inches deep and about 20 inches apart. The water should then be run into the corrugations until the ground is thoroughly wet. As soon as the surface of the ground is sufficiently dry to work it should be harrowed down and planted. If properly done, a good stand of beets can be secured in this manner without danger of crusting, and the ground should contain enough moisture to carry the plants beyond the thinning period. Whether the germination is produced by the moisture already in the soil or whether it is produced by irrigation, the plants should be carried just as long as possible after they are up before they are watered. The object in withholding the water as long as possible is to produce long roots, since long roots are essential for a good tonnage.

In watering beets after they are up they should never be flooded, but should be watered in furrows between the rows. This is especially important while the beets are small, since flooding at that time is likely to scald the beet stems and to produce a crust on the surface of the ground around the beets which cuts off the air supply in the soil and retards the growth of the plants. Usually suitable furrows between the beet rows can be made by means of the irrigating shovels, which may be attached to the cultivator. If the furrows made in this manner are not deep enough and smooth enough to carry the water readily, which will depend upon the slope of the land and the nature of the soil, they should be logged out. This can be done by running the corrugators behind the cultivator. If the corrugators are used for this purpose the runners should be 20 inches apart except when the soil is of such a nature that the water seeps out readily. In such cases irrigation in every other row is sufficient and the runners of the corrugators should be 40 inches apart. The same implement can therefore be used to prepare the ground for watering before planting and after the beets are up. If it is desired to irrigate in every other row, it is necessary only to remove each alternate runner of the corrugator.

After the furrows are properly prepared, the water should be allowed to run slowly through them, so that they will not overflow and so that the ground will be thoroughly wet down and the water seep out to the beets. Figure 2 shows the sort of flooding against which the above warning is directed and figure 3 the after results of such a method of irrigation. The soil bakes and cracks and the plants can not thrive under such conditions. After each watering the ground should be cultivated just as soon as the surface is dry enough to work. The mulch produced by the cultivator should be maintained by frequent cultivation in order to hold the water as long as possible. The point is, in this connection, that cultivation should be made to take the place of irrigation to the fullest possible extent, and in no case should irrigation be expected to take the place of cultivation. In general, cultivation is less expensive than irrigation and it is much more satisfactory if done with care and with due regard for the requirements of the plants.

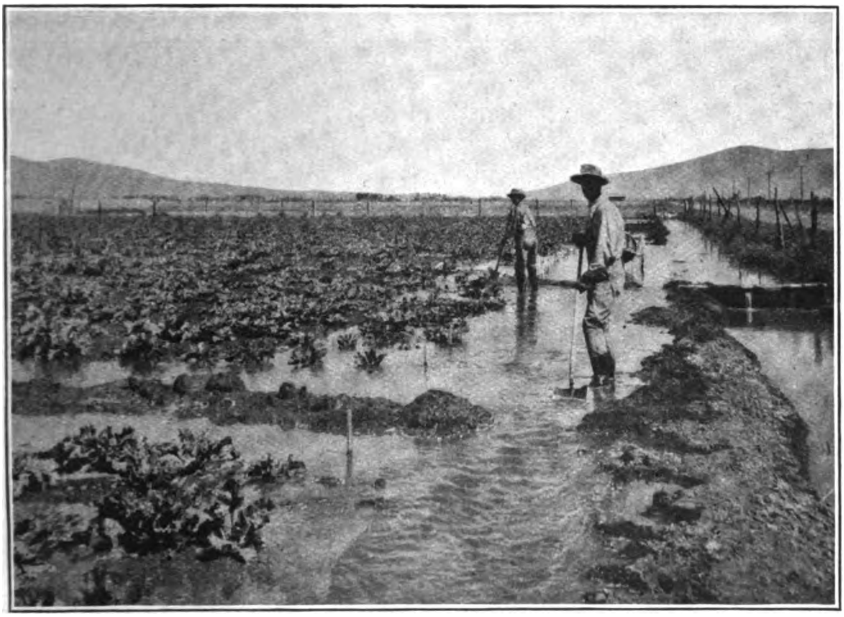

FIG. 2.—A sugar-beet field, showing an improper method of irrigation by flooding the ground, which should be avoided.

The quantity of water that should be applied in order to produce a crop of beets can not be stated in specific terms, since the water absorbing and retaining ability of different soils varies and the rate of evaporation varies both in different localities and in the same locality under the constantly changing atmospheric conditions. It is seldom that two fields will require the same amount of irrigating water to produce the best results. The plants themselves should be the index as to the quantity of water required. It is a well-known fact that all life is dependent upon water, but that too much, as well as too little, water is detrimental to plant growth. In no case should the beets be made to suffer in either direction to the extent of retarding growth. So long as the beets have a fresh appearance and a bright-green color they are not suffering for lack of water, and if furrow irrigation is practiced there is little danger of giving them too much water. If the beets are flooded and the water is allowed to stand on the surface of the ground for several hours, the air is excluded from the beet roots and the plants suffer accordingly. A dark-green color of the beet leaves usually indicates that the water supply in the soil is running low. This is often followed by a wilting of the beets and a consequent retardation in growth. If the wilted beets fail to revive during the night, practically no growth can take place and water should be applied immediately.

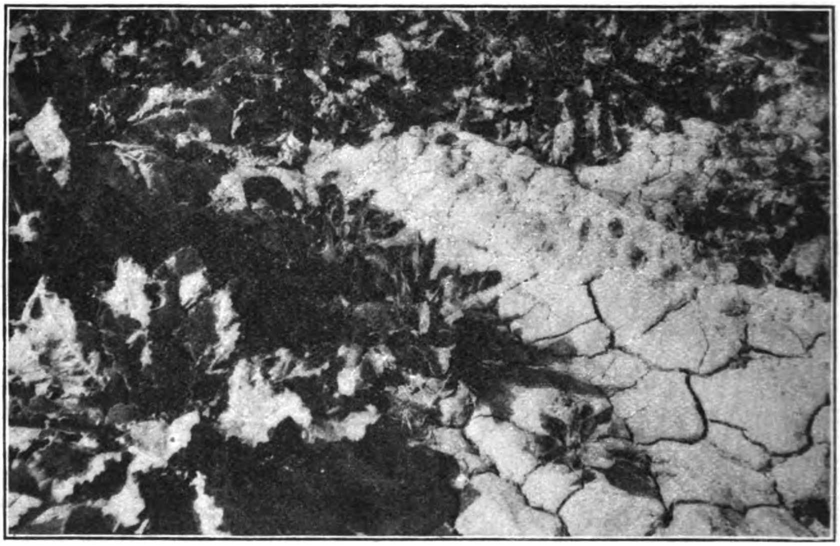

FIG. 3.—The surface of a sugar-beet field, showing its baked and cracked condition resulting from improper irrigation.

HOLDING THE MOISTURE.

By nature soils vary within wide limits as to their water-holding capacity. For example, a fine, compact soil is capable of holding more moisture than a coarse or loose soil. One of the prime objects, therefore, in making fine, compact seed and root beds is that more moisture may thereby be retained in the soil for plant growth. Likewise, fall plowing not only affords an opportunity for the soil to absorb the winter rains and snows, but the ground becomes compact by the action of the elements and is for this reason capable of holding its moisture for a much longer time. It is almost impossible to pack the soil by artificial means as thoroughly and uniformly as it can be done by nature. For this reason spring-plowed land is much more liable to lose its moisture and therefore to require a greater amount of irrigation from the standpoint of compactness alone. In addition to these cultural methods as factors in retaining soil moisture, the importance of a good supply of humus in the soil should not be overlooked. Humus affords a good medium in which the soil organisms can live and thrive and liberate plant food, but they can perform their functions to a much higher degree because of the additional moisture which the soil is able to retain on account of the presence of the humus. If, then, the soil has been supplied with the requisite amount of humus and has been plowed uniformly deep at the right time, much has been done toward furnishing the plants with the moisture needed for plant growth. Special attention should then be paid to keeping the surface of the soil constantly in the form of a mulch. This mulch acts as a blanket in retarding evaporation from the soil below. Everyone is familiar with the moist appearance of the ground under a layer of straw, manure, or other loose covering as compared with the exposed surface of the adjacent ground. The dirt mulch over the field serves more or less perfectly the same purpose that is served by the straw or manure mulch.

PLANTING THE SEED.

If the seed bed has been thoroughly prepared, the principal factors to be considered in connection with planting the seed are the time and depth of planting, the quantity of seed used, and the distance between rows. As already stated, the seed should not be put into the ground until the soil is warm enough to produce a quick germination and a rapid subsequent growth. Nothing is to be gained by putting the seed in the ground before the soil has reached the proper degree of warmth. Indeed, if the seed lies in the ground when the conditions are not right for germination it is liable to rot, and even if it does not rot, the resulting plants, when they do finally develop, will usually be weak and unsatisfactory.

The desire to give the plants every advantage of a long season often leads to the mistake of planting too early. Experience has shown that almost invariably the plantings that are made later, when the temperature conditions for germination and growth are right, give the best results in tonnage and quality, and the beets usually mature in advance of the earlier plantings. On the other hand, the planting should not be delayed until the moisture has escaped from the seed bed. Therefore no date can be specified as the best time for planting, but the soil itself should be the guide in this operation. Usually there is a period of from four to six weeks, and in some localities a still longer time, when conditions are right for planting. This is a wise provision of nature and enables the farmer who desires to plant a large acreage and whose labor in caring for the beets is limited to make several plantings at intervals of a week or 10 days. By this means none of the beets need grow too large before they are thinned. This is a point that will be more fully considered under the subject of thinning the beets.

The seed should be planted just as shallow as is consistent with quick and uniform germination. The depth of planting will vary, therefore, with the nature of the soil and the condition of climate. The seed should always be put into moist soil and the soil should be capable of holding its moisture long enough to produce germination. In some cases these conditions will be met by planting the seed one-half inch deep, while in other cases it may be necessary to plant 1½ inches deep. It is questionable whether it is ever wise to plant more than 1½ inches deep, for the reason that the beet seed proper is comparatively small and the young plant must be able to get through to the light by using the reserve plant food in the seed. If the depth is too great, either the food supply will become exhausted before the plant breaks through the ground or it will become so nearly exhausted that the plant will be weak and spindling.

As an aid in holding the moisture in the soil, the drill should be provided with press wheels, which exert a firm, even pressure upon the soil directly over the drill row. The principle in this connection is that a firm soil holds moisture better than a loose soil. Furthermore, a firm soil acts like a lamp wick and draws the moisture up from below. This emphasizes the importance of having a good supply of moisture in the soil below the seed bed as well as in the seed bed itself. If the pressure of the press wheels is not sufficient to bring the moisture up to the seed bed, the roller, preferably the corrugated roller, will be found useful. Care must be taken to have the ground in just the right condition when planted, so that the action of the drill shoes and press wheels will not destroy the flocculent and friable condition of the soil. If this condition is destroyed, the capillary movement of the soil moisture is impossible and it matters little whether the seed is planted deep or shallow, for the resulting stand will be a disappointment.

Having examined the soil and noted its flocculent condition and the distance to the moisture from the surface, the next point should be to plant all the seed at a uniform depth. The importance of this will be apparent when we consider the operation of thinning the beets. Only two conditions are necessary in order to plant at a uniform depth. First, the surface of the ground must be smooth and firm, the importance of which has for several reasons been emphasized, and, second, the drill shoes must each stand on the same level. The drill can best be set in this respect by standing it on a smooth floor before it is taken to the field.

In order to get a good stand of beets, which is the first requisite of a satisfactory crop, plenty of seed must be used, so there will be no gaps or spaces of any considerable distance where there are no beets. Usually from 15 to 20 pounds of seed per acre will be sufficient to accomplish this result. A reasonable standard of germination and freedom from dirt is required of all beet seed before it is purchased; hence, the only remaining factor to be considered in determining how much seed to plant is that of the size of the seed balls. In general, the smaller the seed balls the greater the number of germs per pound and consequently the smaller the number of pounds required per acre. Therefore, if the seed balls are comparatively small, 15 pounds should be sufficient for a good stand, and if the seed balls are comparatively large not less than 20 pounds per acre should be used, assuming that both lots of seed are up to the standard in germination and capable of producing strong plants. If a large number of seeds germinate at the same time, each plantlet will help others to get through to the light; hence the importance of plenty of seed in a well-prepared seed bed.

Experience has determined that in general the most satisfactory distance between rows is from 18 to 22 inches. In many localities 20 inches has been adopted as the standard distance between rows, although in some cases rows as close as 16 inches will give the best results and in others it is better to have the rows as wide as 24 inches. It is evident that very fertile soil capable of holding an abundance of moisture will yield better results with narrow rows than will a less fertile soil with a lower water-holding capacity. In deciding upon the distance between rows it must be remembered that narrow rows are irrigated and cultivated with greater difficulty than are wider rows. Again, if the slope of the land or the nature of the soil is such that large furrows are required in irrigating the beets, the rows should be farther apart in order to meet the requirement.

SPACING AND THINNING.

As already indicated, the present method of planting beet seed is in solid rows instead of in hills, in order to obtain a more uniform and nearly perfect stand of beets. Having secured a good germination it next becomes important to thin the beets down to one in a place at suitable distances apart in the row to produce a good crop. The first step in reducing the beets to one in a place is that of spacing the beets, which is usually done with a hand hoe used at right angles to the row. In this manner a large number of the plants are cut out and the remaining beets are left in small tufts at intervals of 8 to 12 inches in the row. In performing this operation the hoe should be struck just deep enough so that the beets cut off will not grow again and so that all weeds that may have started in the row will be destroyed.

Several machines have been devised for spacing beets, but they have not come into general use, mainly for the reason that in spite of all precautions the beets are not always uniform as to size and stand, and judgment must be used in spacing; that is, the tufts that are left must sometimes be a little closer and sometimes a little farther apart in order to work out the best results in many fields.

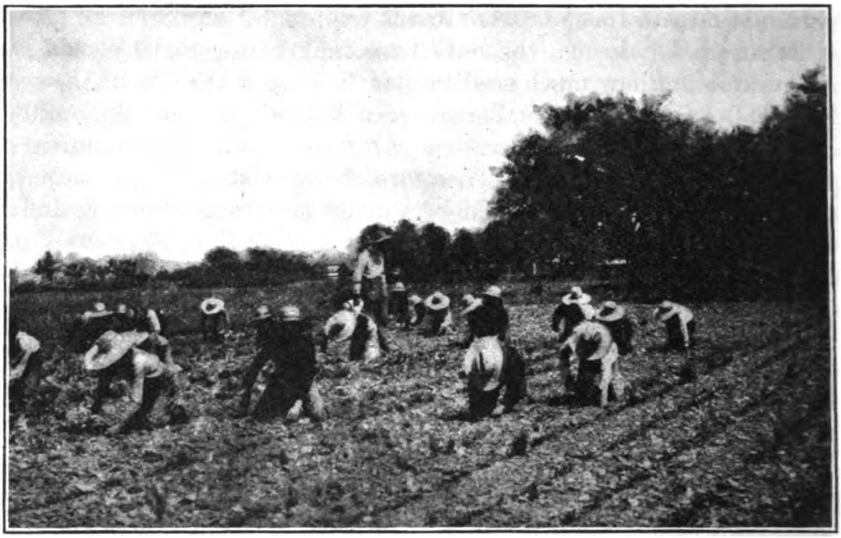

FIG. 4.—Thinning sugar beets. Owing to the closeness of the young plants this work must be done by hand.

As soon as the beets have been spaced, the tufts should be thinned to one in a place. This work must be done with the hands (fig. 4), since the beet plants stand so close together that no machine has been devised that is capable of doing the work satisfactorily. This is the most tedious and at the same time one of the most important operations in producing a crop of beets. It is seldom the case that two beets left in the same tuft will produce the same weight of beet root that would have been produced by either of the beets alone; hence the importance of thinning to a single beet can not be too strongly emphasized.

The beets should be spaced and thinned just as soon as possible after they are up. This can usually be done when the plants have from 4 to 6 leaves. The longer they are left before spacing and thinning, the poorer the chance for obtaining a maximum yield, for the reason that all the beets as long as they are left in the ground are drawing upon the food and moisture supply in the soil and the earlier those that are not desired are removed the better will be the chances for the remaining beets to make a good crop. The same factors that govern the distance between the rows, namely, soil fertility and the moisture-holding capacity of the soil, will govern the distance between the plants in the row. If the rows are 20 inches apart and the beets stand 10 inches apart in the row, each beet will have an area of 200 square inches from which to draw its food and moisture. In general, this is sufficient, but in special cases they should stand a little closer or a little farther apart in order to get the most profitable crop which that particular field is capable of producing.

CULTIVATING.

There are three principal objects to be accomplished by the use of the cultivator, namely, the destruction of weeds, the retention of moisture, and the interchange of gases in the soil. The purpose for which the cultivator is operated should be kept in mind, and the cultivator should be fitted with attachments accordingly. In using the weeders care should be taken that they do not form a crust just below the mulch produced by the weeder blades. This may be avoided by attaching calf-tongues just back of the weeder and so setting them that the points operate a little deeper than the weeder blades.

Some growers are partial to the disks when the beets are small. These are useful if the main object is the formation of a mulch or if a light crust has formed which it is desired to break and at the same time to form a mulch. The disks, if properly set, prevent the dirt from being thrown over the young beets, which is a point that should be strongly emphasized at every cultivation, regardless of the kind of attachments used. The objection to the disk is that it leaves a furrow on either side of the beet row, and consequently the plants stand on a ridge, which is inclined to dry out. To avoid this condition a bull-tongue should be attached back of each of the disks and so adjusted that the furrows formed by the disks are filled in with the loose dirt, so that the surface of the ground is level.

While the beets are small it is safe to cultivate fairly deep and quite close to the plants. The depth to which the ground is stirred when the beets are small should never be as great as the depth to which the roots have penetrated and never need exceed from 3 to 4 inches in order to accomplish the object of the cultivation. As the beets get older it is usually advisable to set the cultivator so that it does not work so deep or so close to the beets, for the reason that the feeding roots must not be disturbed. The manner in which the beets are handled while small, especially with reference to the soil moisture, will govern to a great extent the position of the feeding roots. If the ground is kept rather moist near the surface the feeding roots will develop near the surface and great injury may be done by the later cultivations. This emphasizes the importance of withholding the water from the young beets as long as possible, so that the main root will be long and the feeding roots formed well down on the main root. If this is done a deeper mulch and one that extends closer to the beets can be maintained without injury to the plants. This will be very helpful in retaining the moisture in the root bed and also in maintaining a free circulation of gases in the soil.

Before cultivating it is always advisable to examine the plants with reference to the length of the taproots and the location and length of the feeding roots. The cultivator should then be set accordingly. The time used in making this examination of the plants and in setting the cultivator, if done with care and intelligence, is time well spent. Both the 4-row riding cultivator and the 2-row walking cultivator are in more or less general use. The main advantage of the 4-row cultivator is the rapidity with which the beets can be cultivated, while the 2-row cultivator is slower, but as a rule does better work and destroys fewer beets. Many promising fields of beets are so injured by improperly adjusted and carelessly handled cultivators that they become sources of loss rather than of profit to the grower. The constant aim should be to keep the beets growing from the time they come up until they are harvested and to destroy just as few of them as possible.

HOEING.

Beets receive their first and in many cases their only real hoeing at the time they are thinned. At this time the ground is or should be thoroughly stirred around each beet. The hoeing should be deep enough to destroy all weeds in the beet rows and to form a continuous mulch around and between the beets. The subsequent hoeings should be frequent enough to keep down all weeds and to maintain a continuous mulch in the beet row, so that the hoeing combined with the cultivation maintains a continuous mulch over the entire surface of the field and keeps it entirely free from weeds throughout the season. Unfortunately, in practically all sugar-beet localities all hoeing after the beets are thinned consists simply in cutting out the weeds in the beet rows. The consequence is that the ground in the beet rows is not stirred from the time the beets are thinned until they are harvested except at the points where weeds appear. This permits the formation of a crust, in many cases the entire length of the beet rows, through which an enormous amount of soil moisture escapes and is lost so far as its immediate effect upon the growth of the plants is concerned.

The destruction of weeds is of vital importance, since if allowed to grow they rob the soil of both moisture and plant food, but the stirring of the ground between the beets in the row should not be overlooked. The hoeings should be frequent enough to accomplish the destruction of all weeds as soon as possible after they begin to grow and to maintain a continuous mulch over the entire surface of the field until the beets are laid by.

HARVESTING.

The proper time for harvesting the beets is usually determined by certain tests which show the sugar condition and purity of the juice in the roots. Each sugar company has its standard for these factors of quality, and until the roots measure up to this standard they are not considered sufficiently mature to be harvested profitably. As soon as a sufficient number of fields show beets of proper quality for harvesting, orders are given and the roots are prepared and delivered to the sugar mill or loading station. Harvesting beets consists of several distinct operations, i. e., lifting, pulling, topping, piling, and hauling.

Lifting the beets consists in loosening them so that they can be easily pulled. Two forms of lifters are in general use. One is a double-pointed implement so constructed that one point passes along on either side of the beets and at a suitable distance from the surface so that the beets are slightly raised out of the ground. The other is a single-pointed implement somewhat resembling a subsoil plow. This passes along on one side of the beet row and loosens the dirt so that the beets are easily pulled and is called a side lifter. The kind of lifter that will give the best results depends upon the condition of the soil. The side lifter usually has a lighter draft than the double-pointed implement. Aside from the draft, the important points are that all the beets be loosened and that as few roots as possible be broken. Both of these factors are often a matter of good driving. After the beets have been loosened they are pulled and thrown in piles or rows. The number of beet rows used in making one row of piles or one row of pulled beets is often a matter of convenience and usually consists of from 16 to 24 rows of beets. The principal point is that the greater the number of rows the larger the piles, which is of considerable importance in loading the beets.

After the beets have been pulled they are topped. This consists in cutting off each beet at the line of the lowest leaf scar, which is usually done by one stroke of a heavy knife. The object in topping the beets is to remove the leaves, which contain but a small amount of sugar, and to remove the crown or upper part of the beet, which contains a large percentage of the mineral matter taken up from the soil. The mineral matter prevents a given amount of sugar from crystallizing and for this reason should not be allowed to get into the juices in the mill. When the beets are topped the roots are thrown into piles (fig. 5), from which they are loaded on wagons by means of specially constructed forks; that is, the fork tines have knobs on the ends to prevent the tines from puncturing the roots. Before the beets are topped the ground where they are to be piled should be freed from clods and refuse material, so that nothing but clean beets will be forked to the wagons. If the beets can not be hauled immediately after topping they should be covered to prevent evaporation or freezing. If the weather is not cold enough to freeze the beets it is usually sufficient to cover the piles with the beet tops, but if there is danger of freezing a sufficient quantity of earth should be thrown over the piles to prevent the roots from becoming frosted. When the beets are delivered to the sugar mill or loading station, they are tared. The tare consists of two parts, the dirt tare and the crown tare. The dirt tare is the percentage of dirt that clings to the roots when loaded and the crown tare consists of the percentage of crown left on the roots, due to improper topping.

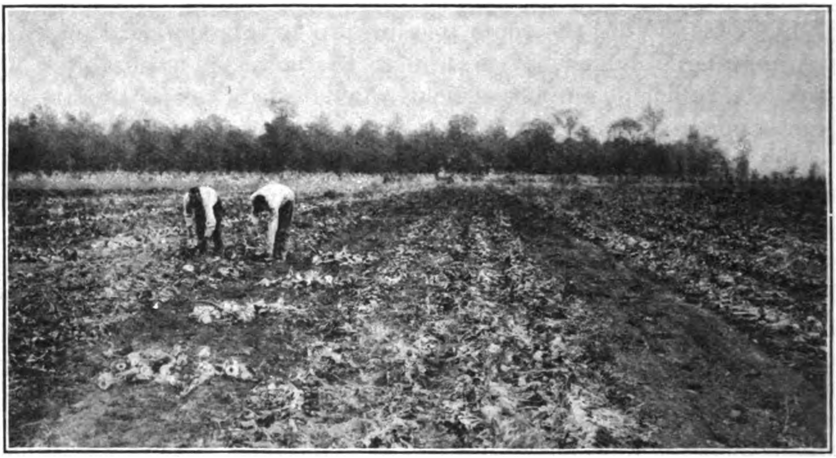

FIG. 5—Topping and piling sugar beets.

CROP ROTATION.

Every farm should have a well-defined system of crop rotation. The object of crop rotation, if properly arranged, is twofold. Each crop should leave the ground in better condition for the next crop than it was before, and each crop should prevent the propagation and development of plant pests. The fallacy that sugar beets injure the soil has not only been exploded, but just the reverse has been found to be the fact. It is true that sugar beets take out of the soil the same elements that are removed by other crops, but in slightly different proportions. But, as has been stated, a large part of these mineral elements is in the top, which, if properly handled, will be returned to the soil in the form of manure, so that in the end but little plant food is removed from the soil by the beet crop. Furthermore, the beet crop leaves the soil in good tilth for the next crop. Experience in all sugar-beet countries has demonstrated the fact that larger crops of grain can be grown after beets than after any other crop so far as known. This seems to be due to the excellent condition in which the soil is left by the beet crop and to the depth of the root bed occupied by the beet roots. It is not apparent that sugar beets add any fertilizing material to the soil, but the fibrous roots that are left in the ground when the beets are harvested improve its physical condition.

No hard-and-fast system of crop rotation can be laid down for any community, but it must be carefully worked out for each farm. There are certain general principles that will apply to all crop-rotation systems. If sugar beets are to be one of the crops in the rotation system, the crop preceding the beets should be of such a nature that it can be harvested in time to plow the ground for beets in the fall. One of the crops in the system should be a legume, such as alfalfa, peas, beans, etc. These are nitrogen-storing crops, and if the soil is deficient in humus, as is the case in most of the irrigated sections, a green crop should be plowed under. Not more than two sugar-beet crops should be grown in succession on the same field, chiefly for the reason that a continual cropping with sugar beets tends to promote the development of serious pests, such as leaf-spot, root-rot, and insects. It is true that more than two crops of beets may sometimes be grown in succession, but it is a dangerous practice and should be avoided.

FERTILIZERS.

As a rule, the soils in the irrigated sections of the country are rich—that is, they contain in abundance the mineral elements necessary for plant growth; but in many cases these mineral elements are not soluble and therefore are not available for the use of the plant. Under such circumstances the soils, while rich, are not fertile. This distinction between a rich soil and a fertile soil should be kept constantly in mind in dealing with the subject of fertilizers. If one or more of the required elements is lacking or is not present in the soil in sufficient quantity to produce a normal plant growth, it is clear that such element or elements should be added in an available form. If, however, the necessary plant foods are all present in the soil but some of them are not soluble, the problem is entirely different and consists in so treating the soil that all the elements are reduced to soluble forms. Frequently the fertility of a soil may be increased by giving it proper tillage at the right time without the addition of any material. However, when we speak of a fertilizer we usually have in mind one or more substances which added to the soil tend to accelerate plant growth. These substances are classed as vegetable or mineral fertilizers.

The vegetable fertilizers in common use are stable manure and green crops, while the mineral or so-called commercial fertilizers contain one or more of the elements known as nitrogen, phosphorus, and potash. It is true that the vegetable fertilizers contain small quantities of the mineral elements mentioned, but the principal function of the vegetable fertilizer is to so improve the physical condition of the soil that the elements already in the soil are rendered soluble and therefore available for the plant. Nearly all irrigated soils are deficient in decayed vegetable matter and humus, and for this reason the importance of making and properly utilizing the greatest possible amount of stable manure can not be too strongly emphasized. The quality of the manure will depend to some extent upon the kind of feed used, but even the poorest quality is too valuable to be wasted. It should be hauled out, evenly spread upon the field, and plowed under as soon as possible after it is made.

As a rule, the amount of stable manure produced upon most farms is insufficient to supply the required quantity of humus to irrigated soils. For this reason the stable manure should be supplemented by plowing under green crops. These are of two classes, those which do and those which do not store nitrogen from the air. If the supply of nitrogen in the soil as well as the supply of humus is deficient, nitrogen-storing plants, such as alfalfa, clover, peas, beans, etc., should be used as a green fertilizer. If the humus only is deficient, such crops as rape, rye, sorghum, etc., may be used. It should be remembered that a good supply of humus in the soil not only improves its fertility but increases its water-holding capacity. A soil which is deficient in one or more of the mineral elements will not respond to the fullest extent to the addition of mineral fertilizer unless there is a sufficient amount of humus present to put the soil in good physical condition. Therefore, the physical condition as well as the chemical composition should be carefully considered in the effort to increase the fertility of soils.

LIVE STOCK.

One of the most important adjuncts of a farm on which sugar beets are grown is live stock, especially dairy cows. It is doubtful whether any sugar-beet territory can build up a permanent agriculture unless considerable attention is given to the production of live stock. At any rate, no agricultural country can attain its highest development without due regard to this particular line of agriculture. Not only will the live stock, if properly handled, produce an important part of the farm income, but they are very essential in the matter of soil improvement, which is brought about through the proper use of the barnyard manure. The keeping of live stock enables the beet grower to make the best possible use of the beet tops. This feed, in connection with roughage which is easily produced, keeps the live stock in good condition and enables the farmer to return the mineral elements in the tops to the soil and at the same time to increase the supply of soil humus. The supply of humus is of special importance in irrigated sections in that it increases to a marked degree the water-holding capacity of the soil.

Sheep as well as cattle thrive on beet tops, but it is wise to feed them sparingly at first and to increase the allowance as the stock become more accustomed to this feed. The practice in some localities of pasturing the tops after the beet roots have been hauled from the field has the advantage that it saves the time and labor of hauling them, but it is more or less wasteful. Furthermore, the ground is often injured by the trampling of the stock, so that altogether the most satisfactory plan is to gather and haul the tops to the feed yard, where they should be fed in properly constructed racks to avoid waste.

BY-PRODUCTS.

The by-products of the beet field and sugar mill that are of special importance to the farmer are the beet tops, the pulp, and the waste lime. The value of beet tops as a stock food has been briefly mentioned. If properly handled they form a valuable asset for the beet grower, and in considering the value of a beet crop they should be reckoned at their real worth as a stock food. Many farmers sell the tops for a cash price ranging from $2.50 to $5 per acre. In this case the beet grower is the loser, for two reasons. In the first place, the tops are of greater value to him as a stock food; and, in the second place, if he allows the tops to leave his farm he loses their manurial value, consisting of a large part of the mineral plant food taken up by the beets in the process of growth, and also their humus value, which results from returning the tops to the soil in the form of stable or barnyard manure.

The most economical way to handle the tops is to gather them into piles soon after they wilt and before they become thoroughly dried. In this condition they can be gathered with much less loss than would be the case if they were left scattered over the ground until dried. After they have cured in the piles they should be hauled to the feed yard. The resulting manure should be hauled to the field and evenly spread, preferably with a manure spreader, and plowed under. If the tops are free from disease the manure can be profitably applied to the ground to be used for the next crop of beets. However, if any disease, especially leaf-spot or crown-rot, is noticeable on the beet leaves and crowns, the manure should be used only on ground that is not to be put into beets for two or more years; or, better, the freshly wilted beet tops should be put into the silo, preferably mixed with cut straw or corn stover. Leaf-spot spores are all killed in the silo.

Beet pulp is likewise an excellent stock food. This by-product is the refuse that remains after the beet roots have been sliced and the sugar extracted. As a stock food it may be used either as green pulp—that is, just as it comes from the mill—or it may be dried. The pulp is prepared for the drier by having the excess water pressed out, after which it is subjected either to direct heat or steam heat until it is apparently dry. It may be dried by itself or it may have molasses or other material mixed with it to improve its feeding value. The composition of the dried pulp as guaranteed by one of the large dealers is as follows: Protein, not under 8 per cent; fat, not under one-half of 1 per cent; sugar and starch not under 4 per cent; fiber, not over 20 per cent; extract (carbohydrates), not under 58 per cent. Total carbohydrates, including fiber, not under 76 per cent; ashes, 2½ per cent. While the pulp, either green or dried, is an excellent stock food it is not a balanced ration and should therefore be fed with other protein material. The dried pulp is sacked and may be shipped long distances, while the wet pulp is usually fed near the mill, although it is sometimes transported a considerable distance by rail. In any case farmers, and especially dairymen, will find this by-product an excellent addition to other stock food. The dried pulp will keep almost indefinitely if stored in a dry place, and the wet pulp will keep for several months, even when piled on the ground in the open.

Waste lime is a by-product of the sugar mill which under certain conditions is of considerable value to the farmer in correcting the acid condition of the soil. It is well known that a soil should be neutral or slightly alkaline in order to produce the best results. Lime has the ability to combine with the injurious acids that develop in the soil and thereby render them neutral. If, therefore, a soil is inclined to be acid an application of lime will be beneficial. If just enough lime is added to combine with the acid in the soil, the result will be a neutral soil, that is, one which is neither acid nor alkaline. If an excess of lime is added, the soil will be rendered alkaline. Since a slightly alkaline soil is not injurious to sugar beets or other field crops, it is advisable in case a soil has become acid to give it a good application of lime. Ordinarily, an application of from 500 to 2,000 pounds of waste lime per acre will correct the acidity and otherwise improve the soil. In this connection it should be stated that poorly drained soils are the ones most inclined to become sour, a fact which still further emphasizes the importance of good drainage. It is not necessary that waste lime from the sugar mill be used to correct soil acidity. Any finely divided or air-slaked lime will serve the purpose. However, waste lime may usually be had for the hauling and for that reason is an inexpensive remedy for sour soils.

The physical condition of certain soils may be improved by the use of lime. This is especially true of heavy soils which tend to become too compact. An application of lime to such soils will often render them porous, thereby enabling the farmer to prepare more satisfactory seed and root beds for his crops. Furthermore, such soils will more readily absorb and retain moisture and allow the air to circulate more freely through them.

Lime is in itself an important plant food, and soils deficient in lime may easily be corrected by an application of the waste lime from a sugar mill. In addition to the lime itself, the by-product known as waste lime, lime cake, or sludge contains from 3 to 4 per cent of nitrogen, 4 to 5 per cent of phosphate, and 8 to 10 per cent of organic matter, all of which makes it a valuable fertilizer for soils deficient in one or more of these substances. The value of this by-product has never been fully realized, and it should come into more general use for the purposes mentioned. It has an actual money value that is recognized in Europe not only by the farmers, who purchase large quantities of it for use on the land, but also by the manufacturers of commercial fertilizer, who use it to good advantage as a filler or makeweight in the manufacture of their goods.

SUMMARY.

Sugar-beet soil should be selected with reference to its fertility, its physical condition, its previous cropping, and its ability to be properly drained and irrigated.

The ground should be plowed to a good depth in the fall and every effort made to retain the moisture in the soil from the time the previous crop was harvested until the beet crop is laid by.

The seed and root beds should be so prepared that they will be fine, firm, moist, and well aerated, with a sufficiently lumpy mulch on the surface to prevent blowing.

Beet ground should never be flooded after the seed is planted.

The soil should be well supplied with humus.

Beet seed should be planted in moist soil, but not more than 1½ inches deep.

Beets should be spaced and thinned just as soon as they are large enough to handle.

Beets should be cultivated and hoed often enough to destroy all weeds and to keep the entire surface of the ground covered with a mulch.

Beets should always be rotated with other crops in order to keep the soil in good tilth and free from pests.

Live stock, especially dairy cows, should always be found on beet farms.

The by-products of the sugar beet and of the sugar mill are worthy of careful attention.

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SUGAR-BEET GROWING UNDER HUMID CONDITIONS.

By C. O. Townsend,
Pathologist, Cotton and Truck Disease and Sugar-Plant Investigations.

SOIL.

It is generally conceded that the best soils for the production of sugar beets are the sandy loams and the clay loams. However, any good soil if properly handled will produce satisfactory sugar beets provided the climatic conditions are favorable. In general, more depends upon the physical condition of the soil and the way in which it is worked than upon its strict classification. The physical condition of the soil depends upon a number of factors which are of prime importance in the selection and preparation of the ground for sugar-beet growing. For example, the soil should be well drained and at the same time it should be capable of holding a sufficient amount of moisture for the needs of the beets. Even the so-called muck soils will produce good beets if they are well drained and properly worked. On the other hand, the loamy soils will sometimes produce very poor crops if not well drained or if otherwise improperly handled.

For the retention of sufficient moisture for crop production the supply of humus plays an important part. A soil that is well drained and at the same time properly supplied with humus will not only hold enough moisture for the needs of the plants, but it will permit the air to circulate through it and enable the soil organisms to thrive and multiply, thereby liberating an abundance of plant food.

The nature of the subsoil has an important bearing upon the selection of soil for sugar-beet growing. Hardpan subsoils should be avoided, especially if they are so near the surface that they will interfere with the proper growth and development of the roots. Likewise, the very porous or gravelly subsoils which permit of rapid leaching will not give the best results with sugar beets or other crops, because the moisture passes down too rapidly and not enough is retained in the soil proper to supply the needs of the plants. At the same time, if there is an abundance of rain on such soils, so that the plants are seemingly well supplied with moisture, the soluble plant food, the only kind which is of any use to the plant, will be washed out and to some extent lost. The disadvantages of a porous subsoil may be overcome in a measure by furnishing the surface soil with a good supply of humus and giving it such tilth that as much of the moisture as possible will be retained in the surface soil. In selecting soils for sugar beets, therefore, careful attention should be given both to the soil proper and to the subsoil. In general, if a soil has been producing good crops of corn, potatoes, etc., it will produce good beets provided it receives the proper preparation and cultivation. In selecting a field for sugar beets it is advisable, therefore, to note the kind of soil and its condition, especially with reference to drainage and humus, the kind and quality of the preceding crops, and the nature and location of the subsoil.

The field selected should be reasonably free from weeds, since extreme foulness of ground adds very materially to the cost of growing beets. The beet field must be kept free from weeds if one expects to obtain anything like satisfactory results. It is sometimes claimed that a beet crop is of great advantage in freeing a field from weeds. This is true if the ground is properly handled, but one should see to it that not too large a percentage of the profits of the crop is consumed in fighting the weeds, a condition which may be avoided by careful attention to the preceding crops with respect to weed growth. This emphasizes again the importance of personal knowledge of the individual field. This knowledge the farm owner acquires either consciously or unconsciously if he works his farm intelligently and is a fairly close observer, but the tenant who is constantly shifting from one farm to another is handicapped in that he lacks this personal knowledge of the individual fields, which he should have in order to locate his crops to the best advantage.

CLIMATIC CONDITIONS.

The principal climatic conditions which have an important bearing upon sugar-beet culture are temperature, precipitation, and winds. Other things being equal, an average temperature of about 70° F. during the growing season will usually give the best results so far as the sugar content of the beets is concerned. If the average temperature is very much above this point, sugar does not seem to form readily, and consequently the beets are of poor quality. On the other hand, if the temperature is too low the beets do not grow well and the tonnage is correspondingly low. Aside from the temperature of the growing season, the spring and fall temperatures have much to do with the success or failure of beet culture. Late spring freezes following a favorable period for planting and germination will frequently destroy the young plants and involve considerable extra expense and labor in replanting. A protracted cold spell after the seed is planted will retard germination and growth and often give the beets a setback, from which they frequently fail to recover fully. A well-drained soil, rich in humus, will tend to offset these adverse conditions to some extent.

Cool nights and moderately warm days in the latter part of summer and in the fall are most favorable for the storage of sugar in the beets. The great danger from extreme cold in the fall is that the beets may be frozen in the ground. This sometimes occurs and causes considerable loss to the grower. Every grower should aim to get his beets out and, if necessary, siloed before freezing weather sets in. If the roots themselves freeze, no great amount of damage will result, provided they remain frozen until they are worked through the mill, but if they alternately freeze and thaw, they will soon blacken, decay, and become worthless for sugar-making purposes. Frozen beets should not be put into the sheds with the expectation of leaving them for any length of time, as they will certainly spoil. The only safe way is to get the beets out of the ground before they freeze and put sufficient covering over them so that they will not be frosted.

The amount of precipitation in the form of rain or snow which falls in a given area is beyond our control, but considerable can be done toward getting the full benefit of the precipitation, whether it comes in summer or in winter. If the ground is plowed deep in the fall and left rough, the snow will not blow off, and as it melts it will sink into the ground, where much of it may be held for future use. A good supply of vegetable matter in the soil together with proper tillage will aid materially in holding the moisture, while proper drainage will carry off any excess of water which might be injurious to the plants.

In most of the humid regions where sugar beets are grown winds do little, if any, damage to the sugar-beet crop. But in some areas lying close to the irrigated sections wind control is an important problem, and, indeed, is sometimes the limiting factor in sugar-beet growing. In some of these areas the rainfall would be sufficient to produce a good crop of beets were it not for the hot winds in spring and summer, which frequently increase the evaporation to an abnormal extent. Windbreaks, an abundant supply of humus, and good dirt mulches on the surface of the fields will largely offset the bad effects of these winds. In addition to the influence that these winds have upon evaporation they frequently do considerable damage in blowing the seed out of the ground before it germinates and in cutting off the young plants soon after they come up. To prevent this as far as possible, the surface of the fields in these areas should not be too smooth, but should be kept slightly ridged and somewhat lumpy.

PLOWING.

There are two important points in plowing for sugar beets that should be kept in mind, namely, the time and the depth. Experience has demonstrated that the best results are generally obtained by plowing the ground for beets in the fall. Taking advantage of this fact, the beet grower will try to arrange his work and his crop rotation so that he can plow his beet ground in the fall, provided the soil and weather conditions will permit.

The advantages in fall plowing are numerous and distinct. In the first place, if the ground is plowed in the fall under proper conditions it will be in better physical condition in the spring because of the fact that the weather has had free access to the soil particles and put them in better shape to part with the elements necessary for plant growth. Fall-plowed land also tends to take up more readily the winter rains and snows that fall upon it. This precipitation not only helps to put the ground in better condition for a crop, but it may be made to supply a large amount of moisture to tide over dry periods that are almost sure to come every spring or summer. If the ground is plowed in the fall that much work is out of the way and the rush of work that is always present in the spring is greatly relieved. Fall plowing also enables the farmer to work down his ground earlier, thereby holding more moisture and putting his soil earlier in condition for his crops.

There are, of course, conditions under which fall plowing is impracticable, either because of lack of time or because the condition of the ground makes it impossible. Every farmer of experience knows the injurious effects of plowing ground when it is not in the right condition to be worked. If for any reason spring plowing becomes necessary it is even more important that the ground be in proper condition as regards moisture when plowed in order to make satisfactory seed and root beds.

The depth of plowing is fully as important as the time. It has been demonstrated again and again that deep plowing will give the best results for sugar beets, other things being equal. If the ground is plowed in the fall it is hardly possible to plow too deep, provided the ground is in condition to be plowed at all. If the plowing must be delayed until spring it is not advisable to plow more than 1 or 2 inches deeper than the ground was previously plowed, since too much raw soil on the surface does not make a good seed bed. It is assumed that the plowing is done with a moldboard plow, which is the implement commonly used in humid regions. If, however, the plowing is done with a disk plow the ground can be stirred to a greater depth even in the spring without injury to the seed bed. This is due to the fact that the disk plow has a tendency to mix the top and bottom soils without bringing so much raw soil to the surface as is done with the moldboard plow.

The practice of subsoil plowing for beets is not so common as formerly. The experiments as well as field tests conducted by the writer indicate that the extra expense of subsoiling is not generally justified. There are instances, however, in which this operation should not be omitted. For example, if the plowing for any reason can not be over 7 or 8 inches deep and the subsoil is so hard that the beet roots can penetrate it only with difficulty, the action of the subsoil plow will be beneficial and should not be neglected.

The whole object of plowing should be to make a deep, rich seed and root bed which can be penetrated easily by the beet roots and from which the plants can draw an abundant supply of food necessary for their constant and rapid growth. At the same time, the seed bed must be firm enough to hold the plants securely in place and not so compact that the air can not circulate freely through it. The depth of plowing should be as nearly uniform as possible throughout the field, and the plow should be set so that the entire surface area of the field is turned.

FITTING SEED AND ROOT BEDS.

Plowing is only one step in the preparation of the seed bed for beets, and unless the subsequent fitting of the ground is done with intelligence and care it matters little whether the plowing is deep or shallow. In fact, unless the grower is prepared to work down the soil into a firm seed bed it is better in most cases to plow shallow. It is assumed, however, that the grower wants the best possible seed bed for his beets. If so, he will plow the ground to a good depth in the fall and begin at once the preparation of the seed bed.

If the seed bed is carefully selected and thoroughly prepared, the success of the crop is more than half assured. As already indicated, the seed bed is not only the storehouse which is to supply the plants with food material and moisture, but it must be a medium for holding the plants firmly in place during the growing season. The root must be constantly in contact with the fine moist particles of soil; otherwise, it can not dissolve and take up the mineral elements necessary for the growth of the plant. The root needs also a certain amount of air, and the soil should therefore be in such physical condition that the air can circulate freely through it. At the same time no air spaces of any appreciable size should be allowed to remain in or below the seed bed. Air spaces are detrimental in that they allow the seed bed to dry out too rapidly and do not permit a sufficiently firm and uniform medium for the proper growth of the plants.

The primary aim, therefore, in fitting the seed bed for beets should be to make it deep, fine, and firm. If the ground was thoroughly worked for the preceding crops and is in proper condition when plowed, the subsequent fitting of the seed bed will be much easier. If the ground is plowed in the fall, the winter rains and snows will tend to make it sufficiently compact. If the plowing is done in the spring, or if the nature of the soil is such that it will not be sufficiently firmed by the natural elements, the plowing should be followed by a subsurface packer. It is not sufficient to pack the surface of the ground only, which is so frequently done, but the lower part of the seed bed, which is, strictly speaking, the root bed, must be thoroughly firmed. In the spring, as soon as the ground can be worked, it should be harrowed or disked. If the field is free from weeds a good harrowing to hold the moisture will be sufficient, but if weeds are starting, it will be best to double-disk and then harrow. The roller is a useful tool in firming the surface of the seed bed, and the alternate rolling and harrowing of the field will usually put it in good condition for planting, provided the lower part of the seed bed has been well firmed by either natural or artificial means.

Care should always be taken never to work the ground when it is too wet, as that invariably injures the texture of the soil, prevents the free circulation of the air, and renders the formation of a first-class seed bed impossible. The object sought, namely, the making of a deep, firm, well-drained, well-aerated, moisture-holding seed bed, should be kept in mind, and the methods employed and the tools used in securing the desired results must be governed to some extent by the condition of the individual field.

DRAINAGE.

Drainage is one of the important factors in beet growing in humid regions, as it is an important factor in the production of all kinds of crops under all conditions. Drainage is of two kinds, natural and artificial. Natural drainage may be due to the porosity of the soil, which allows the water to pass through it readily, or it may be due to the slope of the surface soil or the slope of the subsoil. Naturally drained soils may or may not be good crop producers. If the water passes through or off from the soil too rapidly the fertility is liable to be leached or washed out to such an extent that the soil is deficient in humus and lacking in the required amount of moisture for crop production.

Soils may be drained artificially by means of the open ditch or the blind ditch. In most beet-growing sections the land is too valuable to admit of the use of the open ditch to any considerable extent, except under some conditions as outlets for the blind ditches. For this reason the blind ditch in which tiles are commonly used is the most general method employed in artificially draining beet land. No invariable rule can be given for the depth at which tiles should be laid, but in general they should be deep enough so that they will not be disturbed by deep plowing, and at the same time near enough to the surface so that the water will readily find its way into them. The depth must therefore be governed by the nature of the soil. The hard subsoil which holds the water and causes undrained soil to become water-logged should be deep enough to allow the tile to be laid at or near the surface of this water-holding stratum without being disturbed by the plow; otherwise, the conditions are not good for beet growing. The tiles should form a continuous, but very gentle, slope and should be large enough to carry the water off readily. The rows of tile should be sufficiently close to drain the entire water-logged area.

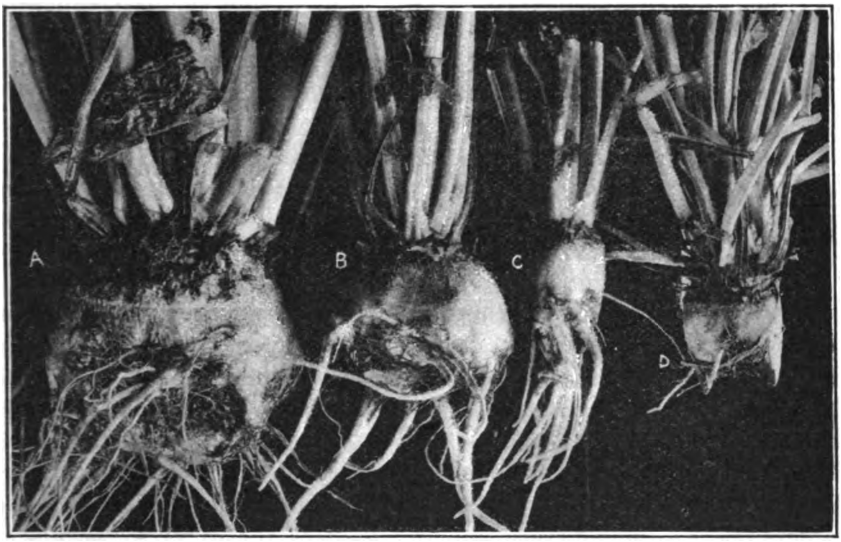

FIG. 1.—Sugar beets, showing the effect of water standing in the field, due to poor drainage.

While sugar beets are hardy and thrive under many adverse conditions, there is no crop that responds more readily to good drainage, and therefore the initial cost of artificial drainage for sugar beets is a paying proposition which leaves the land in better physical condition for other crops.

Figure 1 shows the effect of water-logged land on beets. Such roots as those shown in this illustration are not adapted to milling, and in large quantity they would be liable to rejection by the factory.

HOLDING THE MOISTURE.

The ability of the soil to hold the required amount of moisture for plant growth is of equal importance to good drainage. In order to get a clear notion of this fact it should be remembered that soil moisture exists as free moisture or water that will readily flow off or through the ground under proper conditions, and also as moisture which adheres to the soil particles and keeps them damp. A soil which allows practically all the moisture to pass through it or to evaporate and leaves it comparatively dry in a short time is in poor condition for crop production. This unfavorable condition may be overcome to a considerable extent by properly handling the soil.

If the suggestions given in regard to preparing the seed and root bed are followed and the soil is left firm and compact, it will hold moisture to a far greater extent than if left loose and porous. The crusting or baking of the soil should, of course, be avoided, as this condition favors rapid evaporation. Again, a good supply of humus in the soil aids very materially in retaining the desired amount of moisture.

PLANTING.

WIDTH OF ROW.

For a number of years there has been considerable difference of opinion among beet growers in regard to the most profitable distance between the rows. In our experiments, conducted for a number of years at different places in which the distances 20, 24, and 28 inches were used, we invariably found that the most profitable distance was 20 inches, everything considered. It is true that the narrower rows require more work because of the larger number of rows per acre and greater care in cultivation, but in all cases the extra expense was more than offset by the heavier yield, even though the individual roots were sometimes smaller. In a few experiments 18 and 22 inches were tried, but the results did not differ materially from the 20-inch rows. Considering the yield as compared with the cost of growing the beets with different widths of row, 20 inches is most generally satisfactory. One argument in favor of the wider row is that the grower in using the wide row is able to utilize a corn cultivator and thereby avoid the expense of an extra tool for cultivating his beets. However, good strong land that is capable of growing a satisfactory row of beets every 20 inches will soon pay for a beet cultivator in the extra yield, and if one expects to remain in the beet-growing business, as most growers do after trying it for two or three years, it will certainly pay to have a beet cultivator, even if the acreage each year is small.

DEPTH OF PLANTING.

The depth at which beet seed should be planted is an important consideration for a good stand of beets. The quicker the leaves get through to the light and the roots strike down into the firm root bed the better the stand and the stronger the plants will be. Therefore shallow planting, one-half to three-fourths of an inch, is advisable provided there is moisture enough to produce germination. The seed should be placed in the moist soil at such a depth that the moisture can be kept in contact with the seed until the roots have begun to develop.

Every grower of experience realizes that soils differ considerably in their ability to hold the moisture near the surface. Climatic conditions have a marked influence on soils in this regard. In general, the depth of planting will vary from one-half inch to 1½ inches. Good stands are sometimes obtained with still deeper planting. In such cases, however, a slight crusting of the ground or a reduction of the temperature of the soil may retard the germination and growth of the seedlings, causing them either to fail to get through to the light or to get through in a weakened condition. It is therefore much safer to plant shallow and then use every effort to keep the moisture near enough to the surface to produce a quick and even germination.

The press wheels on the drill are important agencies in holding or bringing the moisture up to the seed, and should be set so that they will exert a firm and uniform pressure on the drill row. In case this pressure is not sufficient to produce the desired result, we have found the smooth roller a very satisfactory tool to supplement the work of the press wheels. It is assumed, of course, that the ground is in just the right condition when the planting is done; that is, that the soil is not damp enough to stick to the press wheels and thereby be cemented together after the press wheels have passed over it. The same precaution is necessary when the roller is used, so that the ground in both cases will be left firm but mellow.

It is important also that the depth of planting be uniform. This applies to one drill shoe as compared with another and also to the same drill shoe in different parts of the same field. The depth at which one drill shoe plants as compared with another is a simple matter of adjustment, which can best be made on a level, smooth floor before the drill is taken to the field. The problem of making the same shoe plant at the same depth throughout the entire length of the row each time across the field is a question of the uniformity in the surface of the field and uniformity in the firmness of all parts of the field. If there are soft areas, so that the wheels sink in to a greater depth in some places than in others, the seed will be deposited at correspondingly varying depths. Likewise, if there are small depressions or elevations over which the wheels or drill shoes pass, the seed will be planted deeper or more shallow, as the case may be.

The result of uneven depth of planting is a lack of uniformity in the beets when they come up, a condition which is troublesome in thinning. Either the larger beets must be thinned when the smaller ones are too small, or the larger ones must be allowed to get too large.

SPACING AND THINNING.

At the present time practically all beet seed is planted in solid rows instead of in hills. For this reason the beets must be spaced and thinned, since they must stand one in a place at suitable distances apart in order to produce satisfactory yields. The spacing is almost universally done by means of a hand hoe of convenient size, which is operated at right angles to the row, leaving the remaining beets in small tufts at suitable distances from each other in the row. The beets that are removed by the hoe must be cut off at such a depth that they will not grow again. Numerous attempts have been made to devise a power implement that will space several rows at one time. The mechanical construction of such an implement is comparatively simple, but the fact that the beets in the row are seldom uniform in size or in stand makes the use of such a tool unsatisfactory.

It is always desirable to leave the larger and stronger plants to make the crop, and these are seldom to be found at regular and desired intervals in the row. Hence, judgment must be used in spacing the beets. Sometimes the spacing must be a little wider and sometimes a little narrower to meet these requirements, and there is no implement equal to the hoe in the hands of an interested, intelligent, and observing grower. After the spacing has been done the remaining beets should stand in tufts or bunches at intervals of from 8 to 12 inches in the row. If the soil is strong and has a good water-holding capacity, it is safe to leave the tufts a little closer than if the soil is not so strong and has less ability to hold moisture. Spacing the beets is therefore a matter of sound judgment based upon experience and a knowledge of the soil conditions.

Owing to the nature of the seed balls, composed of from one to seven seeds, the seedlings stand very close together in the tufts. This necessitates thinning by hand, which is the most tedious operation in beet growing (fig. 2). The thinning must be carefully done, so that the beets will stand one in a place at intervals governed by the distance between the tufts when the beets were spaced. It is a well-known fact that two beets growing in contact with one another will not give as great a weight of root as a single beet would have produced at that point. This emphasizes the importance of thinning to a single beet in each place and leaving no doubles. The success of the crop depends also to a great extent upon the time at which the thinning is done, as well as upon the care that is exercised in doing it.

In general, the thinning should be done just as soon as possible after the beets get large enough to be handled, which is usually when they have four leaves. The reason for early thinning becomes apparent when we remember that there is in the soil at a given time a given amount of available plant food and moisture, and the earlier the useless plants are removed the more food and moisture will be left for the beets that are to make the crop. The same principle holds true in regard to weeds, which should all be carefully removed from the row when thinning. As in spacing, the tufts containing the largest and strongest beets should be left, so in thinning, the largest and strongest beet in each tuft should be left to make the crop. Unless this point is carefully watched the largest beets will invariably be pulled out, as they are always the easiest to get hold of. These are minor points, but if carefully considered they will make a remarkable difference in the final yield.

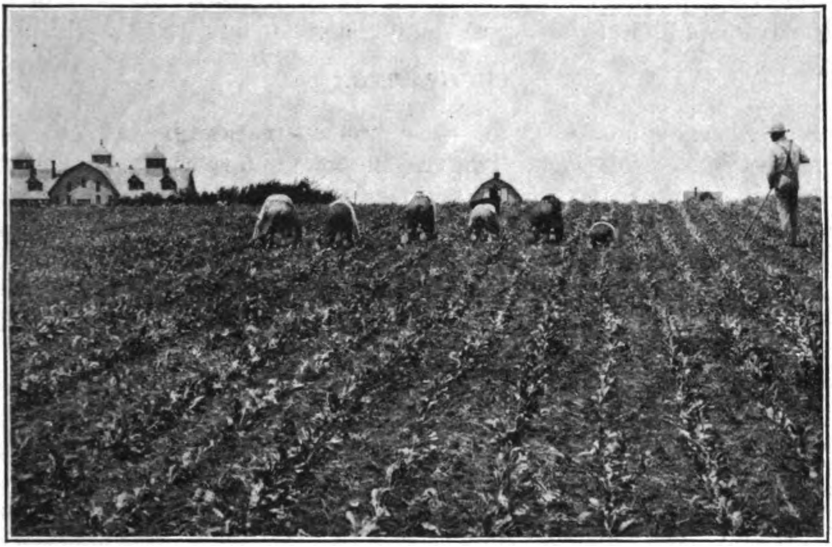

FIG. 2.—Thinning sugar beets. This work, owing to the closeness of the young plants, must be done by hand.

After the beets are thinned they wilt for a time, leaving the bent-over stems exposed to the hot rays of the sun. For this reason the dirt should be drawn up around the plants when thinning, in order to protect them as far as possible.

HOEING.

The beets should receive a good hoeing at the time they are thinned; that is, the dirt should be loosened up on all sides of the beet and all weeds carefully removed. The number of subsequent hoeings will depend upon local conditions. As a matter of fact the subsequent hoeings are not hoeings at all, as the work is usually performed, but consist simply in cutting out the weeds. This work is good as far as it goes, and the so-called hoeings should be repeated often enough to keep the field free from weeds. In going over the field for the first hoeing after the beets have been thinned, a close watch should be kept for doubles, and wherever more than one beet in a place is found all but the largest should be pulled out.

CULTIVATING.

Sugar beets should be given their first cultivation just as soon as the rows can be followed. This can be done before the spacing and thinning and again as soon as the beets straighten up after thinning. No fixed rule can be laid down for the number of cultivations that a field should receive, since this must be governed by weather conditions. In general, there should be a cultivation after each rain, and in case of drought the cultivations should be frequent, in order to retain the moisture below.

It should be kept in mind that cultivation serves three important purposes, namely, opening the soil to admit air, enabling it to absorb and retain moisture, and to destroy weeds. Few people seem to realize that air is necessary to root growth and development, but experience has shown that air is just as essential to the activities of root growth and development as moisture. If the ground is broken up, not only will the air circulate through it, but it will absorb rain more readily, and the dirt mulch formed by cultivation will tend to hold the moisture below. The mulch is more effective if it is granular or slightly lumpy rather than of dust formation.

Weeds rob the soil of both moisture and fertility and therefore should not be allowed to exist either in or between the beet rows. The attachments or combinations of attachments to be used on the cultivator will depend upon the desired object in cultivating; that is, whether it is to break up a crust, to form a mulch, to destroy weeds, or to perform two or more of these operations at one cultivation.

The 2 row walking cultivator (fig. 3) which has come into general use in some localities during the past few years has some decided advantages over the 4-row riding cultivator. Among other things it is more easily controlled, and consequently the damage from cultivating out the beets is greatly reduced. Few growers realize what a large percentage of their beets they sometimes lose by cultivating them out. It may be only a few each time over the field, but these often amount to considerable in the course of the season. The loss from this source is more likely to occur if the rows are crooked or the horses used have not a steady gait.

There is a wide difference of opinion in regard to the depth of cultivating, the distance that the cultivator teeth should run from the beets, and the kind of tools that should be used on the cultivator. These are all details that depend upon the condition of the soil, the size of the beets, and the object to be accomplished by cultivating. If the ground is quite foul, weeders should undoubtedly be used, but they should be followed by deer-tongues set so that they will cut a little deeper than the weeders, in order to make a good mulch and to prevent the formation of a crust just below the mulch. If the ground has a tendency to become hard, the disks followed by deer-tongues properly adjusted will do good work while the beets are quite small. The disks should be set so that the dirt is thrown slightly away from the beets, and the deer-tongues should be set so that they will make a mulch over the entire surface of the ground between the beet rows and at the same time fill the small trench made by the disks. After the beets get larger, the deer-tongues alone are sufficient, or similar tools that will maintain a good mulch and keep the soil open so that a complete circulation of the air in the soil can be kept up.

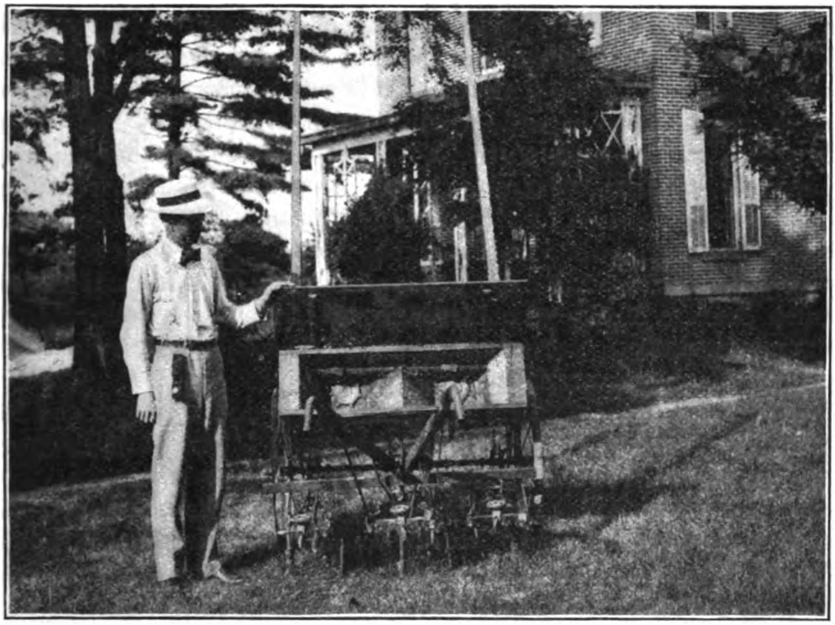

FIG. 3.—One-horse 2-row walking cultivator, with attachment for distributing fertilizer.

In no case should the cultivator teeth be allowed to run deep enough to cut off the feeding roots, and care should be taken to avoid throwing dirt into the crowns of the beets.

As a rule the beet crop is laid by too early. It has been found by repeated experiments on a commercial scale that by continuing cultivation just as long as it is possible to get through the beets, even if some of the outer leaves are broken, the tonnage will be perceptibly and profitably increased without any decrease in the sugar content.

ROTATION.

Every good farmer realizes that the best results are obtained with all crops when a carefully planned system of crop rotation is practiced. We hear now and then of a successful one-crop farmer, but he is always the exception to the rule and it is only a question of time when some pest or some climatic condition will overtake him and show him the folly of such a course. Closely related to the one-crop farmer is the farmer who grows several crops but persists in making each crop follow itself for a long series of years. These methods are attended with a great deal of risk, not necessarily on account of the poor physical condition which often arises from their use and not so much because of the plant foods removed from the soil as from the propagation of pests of many kinds. These pests may be either insects, fungi, or bacteria.

It is well known that each particular pest develops best and increases most rapidly on some particular crop. It sometimes happens that one or more of these pests may thrive upon several crops. For example, the fungous disease known as scab attacks both the white potato and the sugar beet. Hence, potatoes following beets or beets following potatoes may be affected by this disease even though it is the first year that this particular crop is grown in that soil.

It is important, therefore, that care should be exercised in planning a rotation system, in order that the possible evils may be avoided as far as practicable and the best results obtained. No hard-and-fast system of rotation can be advocated for any locality, but a carefully planned system should be worked out for each farm to meet its individual needs. There are some principles, however, of general application, and these should be borne in mind in planning a rotation system in which sugar beets are included.

If practicable, the crop preceding the beets should be of such a nature that it can be harvested in time to plow the ground in the fall for the coming beet crop. The crops preceding and following the beet crop should be of such a kind that they will not serve as food or host plants for the same pests that attack beets. For example, beans preceding beets and small grains following them will meet these requirements fairly well and thereby form part of a good rotation system, provided it fits in with the other farming operations and conditions. There should be one leguminous crop, such as peas, beans, clover, etc., and if the soil is deficient in humus a crop of some kind should be grown to plow under for green manure. This is especially important where the farm does not furnish sufficient stable manure to supply the soil with the requisite amount of humus. There is some danger in following a sod of any kind with beets, on account of the possible presence of wireworms, cutworms, and grubs, which often live over the winter in the sod and are ready to attack the beets the following year. It is safer, therefore, to follow sod with two other crops before planting it to beets.

LIVE STOCK.

One of the most profitable adjuncts of good beet farming is live stock, especially cows. They will utilize the beet tops to the best possible advantage. It is well known that the leaves and crowns of the beets, the parts removed when the beets are topped, contain a large percentage of the mineral matter taken up in the process of growth. If the tops are properly fed to cows, the flow of milk will be increased, the cows put in good physical condition, and the mineral matter and a portion of the vegetable matter may be and should be returned to the soil in the form of stable manure.

Beet tops are good for sheep also, but they should be fed sparingly at first and gradually increased as the animals become used to the new feed. In feeding tops to sheep the general custom is to pasture the tops after the beets have been hauled to the factory. This practice eliminates the work of gathering and hauling the tops, and leaves the droppings on the field to enrich the soil. This method of feeding the tops has one serious disadvantage in that the ground is often in the right condition at that season of the year to be unduly packed by the trampling of the stock. The method of feeding the tops is a detail which may be worked out to best advantage for each farm, depending upon local conditions, and should not deter any farmer from keeping all the live stock that the size of his farm, his system of crop rotation, and the available help will permit.

FERTILIZERS.

The importance and the possibility of not only maintaining but improving the fertility of our soils is recognized at the present time by all intelligent farmers. There are three classes of fertilizers that are useful in accomplishing good results, i. e., stable manure, green crops plowed under, and the so-called commercial or mineral fertilizers. In the long run, no kind of soil improver can be used to the exclusion of the others if we hope to increase the fertility of our soils to the fullest extent and to reap the greatest profit from our labor. As already stated, stable manure is indispensable, but there are few farms on which enough manure is produced to maintain the soil in the best physical condition and to replace the fertilizing elements removed by the crops. For this reason in part, every rotation system should include one crop to be plowed under. Whether the primary object of the crops should be to increase the vegetable matter in the soil or in addition to this to increase the nitrogen content of the soil will depend upon conditions, and selection of the crop should be made accordingly.

If vegetable matter alone is required, such plants as rape, rye, etc., should be used, but if nitrogen also is needed, then plants like peas, beans, clover, etc., should be grown and plowed under. Vegetable matter in the soil is so essential and is so liable to be deficient that the importance of constantly renewing it can not be too strongly emphasized. Briefly, the presence of vegetable matter improves the physical condition of the soil, helps it to retain moisture, and enables the soil organisms to increase rapidly and to do their work in soil improvement. A soil deficient in vegetable matter is said to be dead, which is literally true, and our aim should be to keep it alive and well supplied with air, moisture, and available plant food. We can not increase the actual amount of phosphoric acid and potash in the soil by the use of green manures or by crop rotations, but we can by these means do much to render these elements available for the growing plants.

When we have done all that we can do to increase the available plant food by the use of green crops and stable manure and find that our soils are still too low in one or more of the elements necessary for the best plant growth, we should avail ourselves of the use of commercial fertilizers. These should always be used intelligently; otherwise, loss instead of gain is likely to result. For example, if we plan to use a form of fertilizer that is not readily soluble we should apply it long enough in advance of the crop to give it time to become soluble, remembering that no mineral matter in the soil can be taken up and made use of by the plant until it is dissolved.

HARVESTING.

Harvesting sugar beets consists of three distinct operations, i. e., lifting, pulling, and topping. The lifting is done either with a double-pointed implement somewhat resembling a two-pointed plow, or by means of a side lifter, which is a small shoe or plow on the end of a long shank. The former is so operated that one point of the implement passes along the row on either side of the beets, raising them several inches out of the ground. The latter passes along one side of the beet row and loosens the beets without appreciably lifting them out of the ground. These implements are usually operated by means of horse power, but engines with proper attachments may be used. The kind of lifter to be used is largely a matter of personal choice. As a rule, the side lifter has a lighter draft, but in either case the only precaution necessary is that all the beets be loosened and that as few of them as possible be broken.

After the beets are loosened they are thrown into piles (fig. 4). The number of rows of beets used in making a pile row is a matter of convenience, and it should be remembered that the larger the piles the more quickly the beets can be loaded. When the beets are pulled, more or less dirt will cling to them, but as much as possible of this should be removed by shaking them or by gently striking two or more of them together when pulled. Before topping the beets, the ground where the topped beets are to be piled should be smoothed down and freed from clods, tops, etc., so that the beets can be forked on to the wagon free from all refuse.

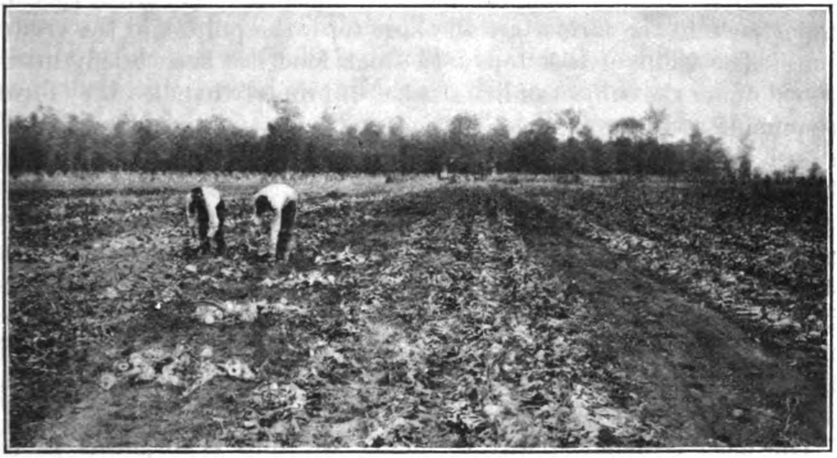

FIG. 4.—Piling and topping sugar beets.

In topping the beets they should be cut off squarely at the lowest leaf scar. This is usually done with one stroke of a heavy knife. When the beets are delivered at the factory or loading station samples are taken and if the beets have not been properly topped the sample is retopped. The percentage of weight removed by this extra topping is called the "crown" tare, and from the sample is determined the tare for the entire load. The tare consists of two parts, i. e., the crown tare and the dirt tare. The latter is the percentage of dirt that clings to the sample as compared with the weight of the roots. In actual practice in determining the tare the sample is first weighed just as it comes from the load; it is then properly topped, the dirt is removed by means of a stiff brush, and the clean sample is again weighed. The difference determines the percentage of tare.

The beets should be covered as soon as possible after they are topped, in order to prevent evaporation. The roots work much better in the mill if they are kept fresh and crisp, and they lose considerable weight if exposed to the sun and wind. If the beets are to remain in the field only a short time after topping it is usually sufficient to cover them with the tops, but if they are to remain for some days, and especially if there is danger of freezing, the piles of roots should be covered with a sufficient layer of earth to protect them.

BY-PRODUCTS.

BEET TOPS.

The by-products of the beet field and sugar mill that are of special importance to the farmer are the beet tops, the pulp, and the waste lime. The value of beet tops as a stock food has been briefly mentioned under the subject of live stock. If properly handled they form a valuable asset for the beet grower, and in considering the value of a beet crop they should be reckoned at their real worth as a stock food. Many farmers sell the tops for a cash price ranging from $2.50 to $5 per acre. In this case the beet grower is the loser, for two reasons: In the first place, the tops are of greater value to him as a stock food and, in the second place, if he allows the tops to leave his farm he loses their manurial value, consisting of a large part of the mineral plant food taken up by beets in the process of growth, and also their humus value, which results from returning the tops to the soil in the form of stable or barnyard manure.

The most economical way to handle the tops is to gather them into piles soon after they wilt and before they become thoroughly dried. In this condition they can be gathered with much less loss than would be the case if they were left scattered over the ground until dried. After they have cured in the piles they should be hauled to the feed yard, where they should be fed in properly constructed racks to avoid waste. The resulting manure should be hauled to the field and evenly spread, preferably with a manure spreader, and plowed under. If the tops were free from disease the manure can be profitably applied to the ground to be used for the next crop of beets. However, if any disease, especially leaf-spot or crown-rot, was noticeable on the beet leaves and crowns, the manure should be used only on the ground that is not to be put into beets for two years or more; or, better, the wilted tops should be put into the silo, where all leaf-spot spores will be killed.

PULP.

Beet pulp is likewise an excellent stock food. This by-product is the refuse that remains after the beet roots have been sliced and the sugar extracted. As a stock food it may be used either as green pulp, that is, just as it comes from the mill, or it may be dried. The pulp is prepared for the drier by having the excess water pressed out, after which it is subjected either to direct heat or steam heat until it is apparently dry. It may be dried by itself or it may have molasses or other material mixed with it to improve its feeding value. The composition of the dried pulp as guaranteed by one of the large dealers is as follows: Protein, not under 8 per cent; fat, not under one-half of 1 per cent; sugar and starch, not under 4 per cent; fiber, not over 20 per cent; extract (carbohydrates), not under 58 per cent; total carbohydrates, including fiber, not under 76 per cent; ashes, 2½ per cent.

While the pulp, either green or dried, is an excellent stock food, it is not a balanced ration and should therefore be fed with other protein material. The dried pulp is sacked and may be shipped long distances, while the wet pulp is usually fed near the mill, although it is sometimes transported a considerable distance by rail. In any case, farmers, and especially dairymen, will find this by-product an excellent addition to other stock food. The dried pulp will keep almost indefinitely if stored in a dry place, and the wet pulp will keep for several months even when piled on the ground in the open.

WASTE LIME.

Waste lime is a by-product of the sugar mill, which under certain conditions is of considerable value to the farmer in correcting the acid condition of the soil. It is well known that a soil should be neutral or slightly alkaline in order to produce the best results. Lime has the ability to combine with the injurious acids that develop in the soil and thereby render them neutral. If, therefore, a soil is inclined to be acid, an application of lime will be beneficial. If just enough lime is added to combine with the acid in the soil the result will be a neutral soil; that is, one which is neither acid nor alkaline. If an excess of lime is added the soil will be rendered alkaline.

Since a slightly alkaline soil is not injurious to sugar beets or other field crops, it is advisable in case a soil has become acid to give it a good application of lime. Ordinarily, an application of from 500 to 2,000 pounds of waste lime per acre will correct the acidity and otherwise improve the soil. In this connection it should be stated that poorly drained soils are the ones most inclined to become sour, a fact which still further emphasizes the importance of good drainage. It is not necessary that waste lime from the sugar mill be used to correct soil acidity. Any finely divided or air-slaked lime will serve the purpose. However, the waste lime may usually be had for the hauling and for that reason is an inexpensive remedy for sour soils.

The physical condition of certain soils may be improved by the use of lime. This is especially true of heavy soils, which tend to become too compact. An application of lime to such soils will often render them porous, thereby enabling the farmer to prepare more satisfactory seed and root beds for his crops. Furthermore, such soils will more readily absorb and retain moisture and allow the air to circulate more freely through them.

Lime is in itself an important plant food, and soils deficient in lime may easily be corrected by an application of the waste lime from a sugar mill. In addition to the lime itself, this by-product, known as waste lime, lime cake, or sludge, contains from 3 to 4 per cent of nitrogen, 4 to 5 per cent of phosphate, and 8 to 10 per cent of organic matter, all of which makes it a valuable fertilizer for soils deficient in one or more of these substances. The value of this by-product has never been fully realized, and it should come into more general use for the purposes mentioned above. It has an actual money value that is recognized in Europe not only by the farmers, who purchase large quantities of it for use on the land, but also by the manufacturers of commercial fertilizer, who use it to good advantage as a filler or makeweight in the manufacture of their goods.

SUMMARY.

Select the field for sugar beets with reference to the quality of the surface and subsoils, the condition of drainage, and their fitness to follow the preceding crop.

Plow thoroughly and deeply in the fall if possible.

Make the seed bed firm below as well as near the surface.

Plant in the spring as soon as the soil and weather conditions are right.

Use plenty of seed to insure a good stand, and do not plant too deep.

Hold the moisture in contact with the seed by the use of the press wheels and the roller.

Cultivate as soon as the rows can be seen, but do not throw the dirt over the beets.

Block and thin the beets just as soon as they are large enough to handle.

Space with reference to the strength and moisture-holding capacity of the soil.

In thinning, aim to leave the strongest and best beets.

Rotate with other crops to improve the soil condition and to eliminate pests.

Keep plenty of live stock to utilize the beet tops and other feed and to supply stable manure.

In harvesting the beets see that they are all gathered, properly topped, and as free as possible from dirt.

Cover the beets as soon as topped to prevent evaporation.

Utilize beet tops, pulp, and lime with a view to improving soil conditions.

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U.S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN
569

Contribution from the Bureau of Animal Industry, A. D. Melvin, Chief.
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TEXAS OR TICK FEVER.

By John R. Mohler, V. M. D., *Chief of the Pathological Division.*

INTRODUCTION.

Texas fever, a very serious obstacle to the cattle industry of the South, has been pretty thoroughly understood since the investigations made by Smith and Kilborne, of the Bureau of Animal Industry. Their work showed conclusively that the cause of the disease was a minute parasite living within the blood cells, the intermediate stage of the development of which occurred in the cattle tick, *Margaropus annulatus*, thus making this tick the indirect but absolutely essential factor in the natural production of the disease. Above the latitude where the cattle tick is destroyed by the cold of winter the disease can be controlled by keeping southern tick-infested cattle from passing through the country during certain seasons. It is also known that by severing the relations of the fever tick and native cattle the former may be exterminated, thus making it possible to eradicate the disease, and thereby to remove a constant menace to the southern cattle breeder, feeder, and dairyman. Especial pains will be taken to make as clear as possible the absolutely proved facts regarding the disease, so that every cattle owner will be able to recognize the malady and to carry out successfully measures for eliminating the tick which causes it.

NAME AND SYNONYMS.

Of the long list of terms applied to this disease, none seems to fill completely all the requirements of an ideal name. "Texas fever," although the term most commonly in use in this country, is a very misleading one, as it gives to the uninformed the impression that the disease is confined to the State of Texas. Southern cattle fever is especially inapplicable, as the disease is usually more virulent in northern cattle when once infection becomes manifest than in southern cattle. Probably the best name to apply to the disease, since it can only be transmitted in a natural way by the tick *Margaropus annulatus*, is that of tick fever. This designation, however, is comparatively little used, and, as the disease is generally recognized in this country under the name of Texas fever, this term will be used in the present work. Other synonyms besides those already mentioned are red water, black water, distemper, acclimation fever, murrain, dry murrain, yellow murrain, bloody murrain, Mexican fever, Spanish fever, splenic (or splenetic) fever, protozoan cattle fever, hemaglobinuria, tristeza, paludism of cattle, bovine periodic fever, bovine piroplasmosis, and bovine malaria.

DEFINITION.

Texas fever is a specific infectious disease of the blood of cattle, caused by the development and activity of minute animal parasites (protozoa) which are conveyed to the affected animals by means of the cattle tick *Margaropus annulatus*. After the microscopic protozoan is injected into the blood of a susceptible animal it attacks the red

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Note.—This bulletin is a revision of and supersedes Farmers' Bulletin 258. It is of interest to farmers throughout the South.

blood cells, causing them to break down. The disease is characterized by high fever, by destruction of red corpuscles, and the consequent excretion of the coloring matter of the blood by the kidneys, causing a reddish discoloration of the urine, by enlarged spleen, engorged liver, thick, flaky bile, more or less jaundice, emaciation, and death in from 10 per cent of the chronic to 90 per cent of the acute cases. The peculiarity about this disease is that the animals responsible for the spread of the malady are apparently healthy, although containing the protozoa in their blood, while those that become diseased do not, as a rule, convey the affection to others. In the few instances where they do, it is not by contact, but indirectly by means of the progeny of the ticks from these diseased animals. Infection is not transmitted by the air, urine, saliva, manure, or in any other natural manner than by cattle ticks.

HISTORY.

Texas fever was probably introduced into the United States with the importations of cattle by the Spaniards during the early colonization of Mexico and southern United States.

The disease caused continual losses year after year during the early history of this country. It seems to have been described first by Dr. J. Pease toward the close of the eighteenth century. At that time a very severe outbreak of the disease occurred in Lancaster County, Pa., and Pease, after investigating the conditions, claimed it to have been due directly to the shipment of some North Carolina cattle into the State. Experience soon showed that the invariable result following the transportation of southern cattle into the Northern States was the death of all northern cattle along the roads and on the pastures over which the southern cattle had traveled, although the latter animals remained perfectly healthy. In the same way northern cattle taken south almost invariably succumbed to the malady.

These losses prompted the study of the disease by many scientific men, whose investigations soon established the great danger of allowing southern cattle to pass into the Northern States during hot weather, and finally resulted in 1885 in the location of the infected district and the establishment of the Texas-fever quarantine line in 1891 by Dr. D. E. Salmon.

Smith, of the Bureau of Animal Industry, was the first (1889) to recognize and describe as protozoa the intracellular parasites which are the direct causative agents of the disease. In 1889 and 1890 Kilborne, of the same bureau, by conclusive field experiments suggested by Salmon, proved the presence of the cattle tick to be essential in the transmission of the disease. It is of interest to note that this was the first experimental proof furnished on the subject of diseases borne by insects, or diseases that can be carried from one animal to another only by an intermediary host. This mode of transmitting infections has since become quite familiar to the public by the discovery that certain species of mosquitoes spread malaria and yellow fever to man.

It was suggested by the experiments of the Bureau of Animal Industry in 1892 and 1893 that, through the production of a mild, nonfatal attack of Texas fever in northern cattle, a very considerable amount of protection is afforded against the disease when these cattle are subsequently exposed to the infection on tick-infested pastures.

From 1895 to 1897 additional experiments were conducted by the bureau with the object of further demonstrating the possibility of immunizing cattle against Texas fever by the use of blood obtained from southern cattle; and experiments with a similar object in view were likewise instigated and perfected about this time at the experiment stations of Missouri, Texas, Mississippi, Louisiana, and by the Australian Government, with most excellent results. Later experiments with the disease have been performed principally with the view of obtaining a satisfactory chemical solution in which to dip tick-infested cattle for the purpose of destroying these parasites, and of developing some methods that may be easily carried out for freeing fields, farms, and counties of the cattle tick.

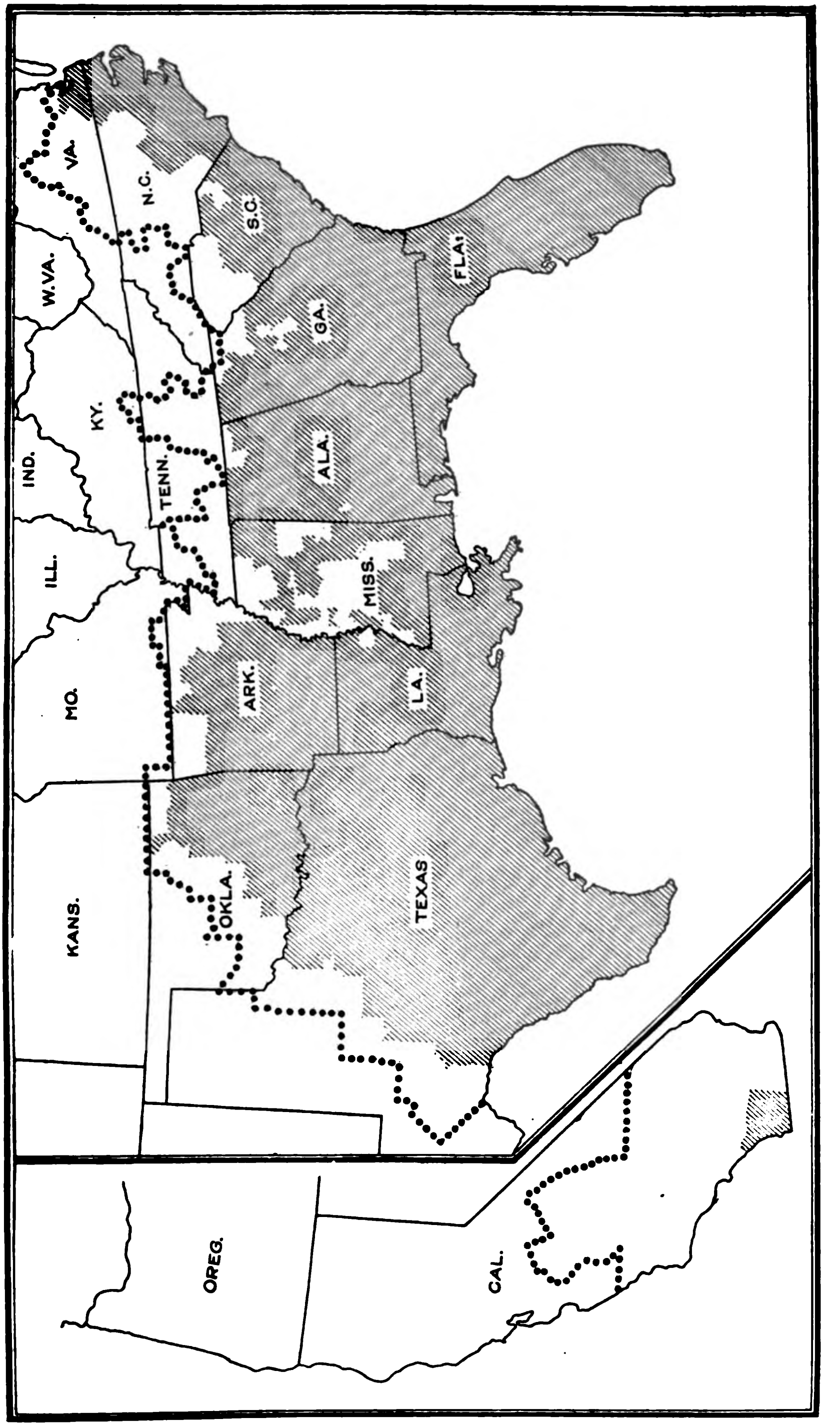

FIG. 1.—Map showing areas quarantined on account of Texas fever and areas freed from ticks; dotted lines show boundary of infected area at beginning of tick eradication in 1906; white areas below dotted line indicate territory that has been freed from ticks and released from quarantine.

CAUSE OF THE DISEASE.

The primary or direct cause of Texas fever is the microparasite *Piroplasma bigeminum*, belonging to the lowest form of animal life, the protozoa. This minute parasite is found in the blood (fig. 2,[1] No. 5) in every case of Texas fever; and by inoculating blood containing it into susceptible cattle, the disease can be invariably transmitted, thus proving its direct causative effect in the production of the malady. After entering into the circulation the protozoa undergo several stages of development which will not be dwelt upon here. The parasites may occupy nearly one-fourth of the body of the red blood cells and, as can be readily understood, exert a detrimental influence upon them. The periphery of these blood cells becomes shriveled or crumpled, and they finally break up, liberating the piroplasma, which may be observed as free bodies in the circulation—most frequently in the kidneys. The stage of reproduction or multiplication of these protozoa has never been observed in this laboratory, but that it does occur is proved by the fact that inoculation of a small quantity of virulent blood into susceptible animals will give rise to the disease with myriads of parasites in the blood. The natural path of entrance of these protozoa, however, is by one channel only, namely, through the bite of the cattle tick. Therefore a knowledge of the habits and life history of the latter is extremely important in controlling the disease, because without this tick Texas fever would be unknown.

LIFE HISTORY OF THE CATTLE TICK AND THE PART PLAYED BY IT IN PRODUCING TEXAS FEVER.

In stating the interesting and important life history of this tick, we will start at the point where the fully developed and fertilized female, being engorged with blood and ready to lay her eggs, loosens her hold on the bovine animal and drops to the ground. Upon reaching the ground she may lie quietly for several days before depositing her eggs, which may consume from four to eight days in summer and two weeks or even longer in the fall. The number of eggs laid by a fully developed female varies from 1,500 to 3,000, while the immature females also lay eggs, but in much smaller numbers. After laying is finished the female is small and shriveled up and, having fulfilled her mission, soon dies (fig. 2, No. 3). The eggs, which are light-brown and waxy in appearance, proceed to develop the larvæ, or seed ticks, the time required for which varies from 13 days to 6 weeks, depending on the conditions of temperature, moisture, soil, etc. These eggs, however, are very tenacious of life, and under unfavorable conditions may remain dormant for several months—from late fall to early spring.

The larvæ, or seed ticks, are minute six-legged parasites of a brownish waxy color, and about $\frac{1}{32}$ of an inch in size (fig. 2, No. 2). They crawl quite actively about on the ground and among leaves, bunching in large numbers upon grass blades, shrubs, weeds, and fence posts, to await an opportunity for attachment to their passing host. The parasitism is so perfect that in case no cattle or horses are present no further development occurs, and death finally results. It is known, however, that these larval forms can live for three or four months on the ground in warm weather independent of their host, and from late September until April during an open winter. When they find cattle, however, they fasten themselves to the soft skin inside the thighs and flanks, on the escutcheon, along the belly and brisket, around the root of the tail, and inside the forelegs (fig. 2, No. 4). They obtain their nourishment by drawing blood from the host, and can cause the fever at this stage, although so small as scarcely to be detected by the naked eye. After being on the animal about one week the seed tick casts its covering (molts) and appears as the eight-legged, nymph stage of the

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[1] 1, larva of cattle tick (× 25); 2, same (natural size); 3, mature female and eggs; 4, hide showing cattle ticks; 5, blood cells containing Texas-fever protozoa (× 1,000); 6, male cattle tick (× 15); 7, same (natural size); 8, young female cattle tick (× 15); 9, same (natural size); 10, various stages of cattle ticks.

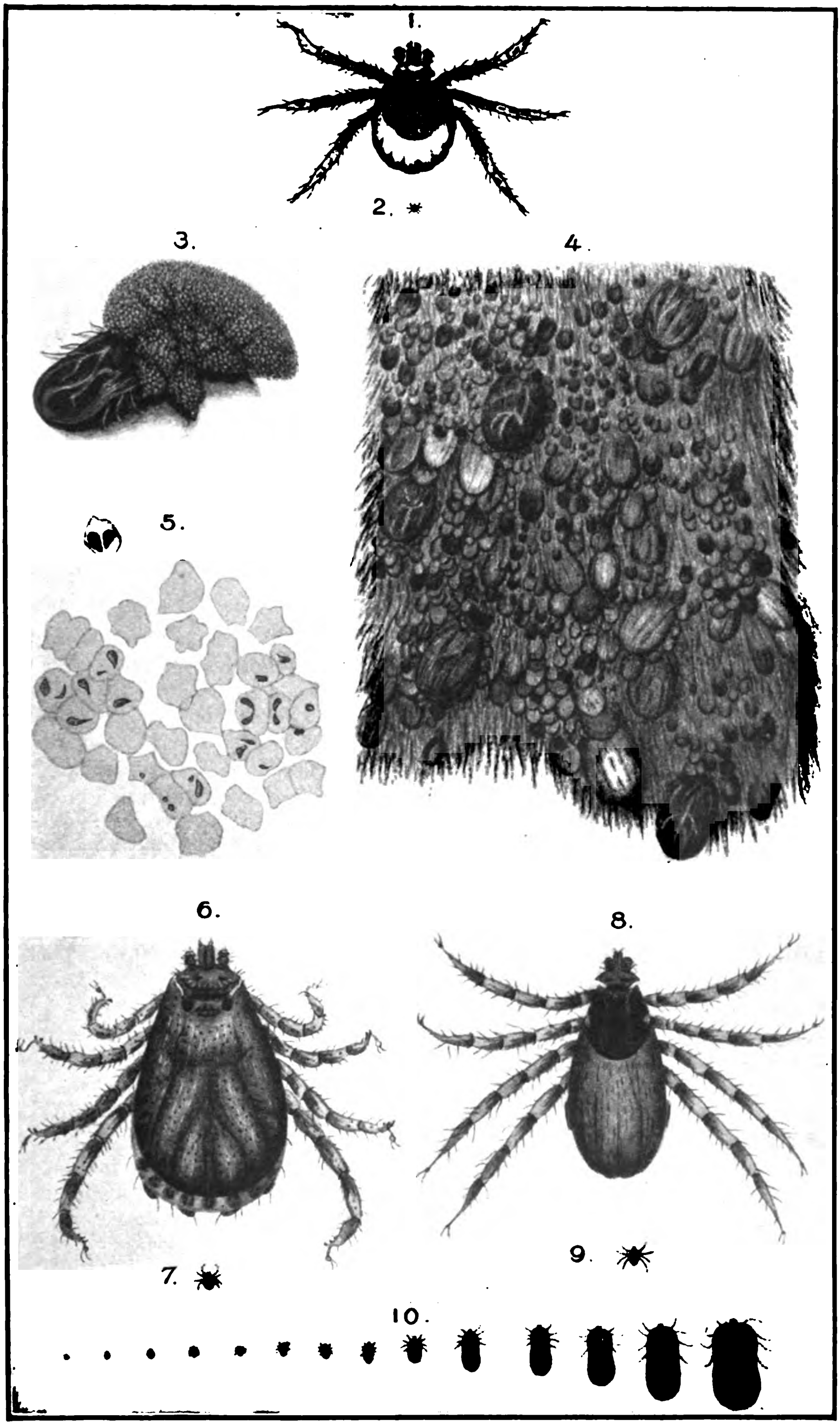

FIG. 2.—Texas-fever protozoa and the ticks which transmit them.

parasite, having added one pair of legs posteriorly. During the nymphal stage the sexual organs develop, and at the second molting, from the nymphal to the adult stage, the sexual organs are complete. The male and female at this stage are about the same size, as the female does not become very large until after she becomes fertilized, which occurs about two weeks after the six-legged seed tick reaches its host, or shortly after the second molting (fig. 2, Nos. 7 and 9). After intercourse with the male the female slowly enlarges for 6 to 20 days in summer, and then rapidly increases in size in the course of a day or two before dropping from the animal. In fall and winter development occurs more slowly, the tick not falling off for six weeks or more. After reaching the ground the female soon commences to deposit eggs, thus completing the life cycle, which requires from 6 to 10 weeks in warm weather, or a much longer period during the cold season.

It will thus be seen that these females transmit the infection through their eggs to their progeny, and the latter have the power to infect any susceptible animal to which they attach. The disease, therefore, is not conveyed by the same ticks which take up the infected blood, but only through the generation descending from them.

Although young ticks are very active, neither they nor the adult ticks are capable of crawling very far, but they may be transported long distances by animals, by rains, by winds, cattle cars, hides, and on the clothing of man. Hence the constant danger that tick-free pastures below the quarantine line may become infested with ticks at any time.

HOW TO DISTINGUISH HARMLESS TICKS FOUND ON CATTLE FROM TEXAS-FEVER TICKS.

The Texas-fever tick is continually confused with a number of other ticks occasionally found on cattle, which, so far as concerns the transmission of Texas fever, are entirely harmless to them. It is this lack of identification and the inability of many cattle owners to distinguish between these various ticks that have caused so many diverse opinions regarding the important part played by the Texas-fever tick in transmitting Texas fever. In order to differentiate between the ticks that may be found on cattle, a brief description of the upper surface of the maturing or adult female of each is here given, together with illustrations of this view of the ticks, natural size, and also magnified four diameters. It is not thought necessary to describe the male and immature female ticks at this time, inasmuch as these ticks are much smaller in size, and therefore it is more difficult to recognize them by means of the naked eye. Moreover, it is usually possible to secure a maturing female in those instances where a diagnosis is desired, and at this stage of development ticks possess certain characteristic features or markings which should cause them to be classified readily as harmful or harmless even by superficial examination.

There are eight species of ticks which have been found on cattle in this country, but the first six mentioned are by far the most common. They all show the same successive stages of development, namely, eggs, larvæ or seed ticks, nymphs, and adult male and female ticks. Those parts of the adult female tick which will be described below are the head and adjacent shield—which together have erroneously been termed the head parts—and the back of the body, since these portions of the parasite furnish features which to the naked eye are the most readily distinguished by cattle owners. Much stress can not be laid upon the color of these various ticks, as it changes considerably with age.

Texas-fever, or cattle, tick (*Margaropus annulatus*).—Figure 3, No. 1a, shows the natural size of an adult female Texas-fever tick, whose characteristic markings are better brought out in No. 1, magnified four times.[1] This tick may be readily distinguished from the other seven ticks by the small size and the color of the head and shield, the so-called head parts, whose lateral borders are straighter and more parallel, as shown in No. 1b. These head parts are short and relatively broad and dark reddish brown or chestnut brown in color. The body is oblong oval in shape and may reach one-half inch in length. The color varies from a dull yellow to an olive brown; often it is mottled with irregular areas of yellow and brown or streaked with wavy lines of these colors. Two grooves or indentations are seen running from the front to the rear on the skin of the back, which become almost, if not entirely, effaced at about the middle of the body. Another groove is seen between these two grooves in the posterior half of the body. These grooves are caused by the contraction of the muscles of the body and therefore vary considerably, entirely disappearing when the tick is full of blood. They are very distinct when the ticks have been removed from cattle several days. The four pairs of legs are brown, moderately long, and very slender. This tick is found principally on cattle, less frequently on horses, mules, and asses, and in one case it was found on a deer.

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[1] In figures 3 and 4 various ticks that infest cattle are shown as follows: The natural-sized mature female tick, this tick magnified four times, and the head and shield of the same enlarged ten to fifteen times.

Castor-bean tick (*Ixodes ricinus*).—The body of this tick (fig. 3, Nos. 2 and 2a) resembles in shape that of an eggplant, and it takes its name from its similarity to the bean of the castor-oil plant. It is lead colored, with a variegated mixture of yellowish red, brown, or gray. The body contains two anterior grooves that slightly diverge from each other, and three posterior grooves, the middle one of which is straight, while the other two are curved outward. The mature female is from three-eighths to seven-sixteenths inch long and has four pairs of dark-brown thin legs. The head and adjacent shield are a shiny dark brown or a chestnut brown, the latter portion being five-sided, like a pentagon (No. 2b), with lateral borders prominent and rear angle rounded. Two stout and well-developed feelers (palpi) may be seen extending outward on each side of the head. This tick has been collected from sheep, cattle, goats, horses, deer, dogs, cats, foxes, rabbits, birds, man, and a few other animals. It was one of the first ticks studied, and has a very wide distribution in the United States.

Net tick (*Dermacentor reticulatus*).—The body of the adult female tick is oblong oval, five-eighths inch long, and of a deep brown or slate color (fig. 3, Nos. 3 and 3a). It has four pairs of brown legs of moderate length. The skin of the back and head is covered with fine points, or punctations, which almost disappear at this stage. Besides the grooves that are located like those in the cattle tick, there is a marginal groove extending around the body just inside the border. There are also 11 small indentations (festoons) arranged about the posterior margin of the body. These festoons and grooves become shallow or effaced in the adult stage. The shield portion of the head parts has a silvery-white metallic rust extending along the two sides and posterior portion (No. 3b). It may have a rose or greenish tinge. The head is larger than that of the cattle tick. The net tick has been found on man, cattle, horses, sheep, and deer; and in this country it seems to be most common in the West, especially in California, Texas, and New Mexico.

American dog tick; also called wood tick (*Dermacentor electus*).—This tick (fig. 3, Nos. 4 and 4a) resembles the net tick (*Dermacentor reticulatus*) so closely that a hand lens must be used to distinguish between them. However, it can be readily known from the Texas-fever tick by the fact that the so-called head parts are longer and broader (No. 4b). Here there is also a yellowish-white rust in the posterior portion which extends anteriorly along each side as two bright, iridescent lines separated by a central brownish area. The body is oblong oval in shape and measures as much as three-fifths inch in length. The skin of the back contains grooves like those found in cattle ticks, and, in addition, another groove extending around just inside the margin, together with 11 smaller grooves (festoons) on the posterior border. These lines, so distinct in the young female, become shallow at maturity. This tick has been found on man, cattle, dogs, horses, rabbits, and panthers, and has been collected in

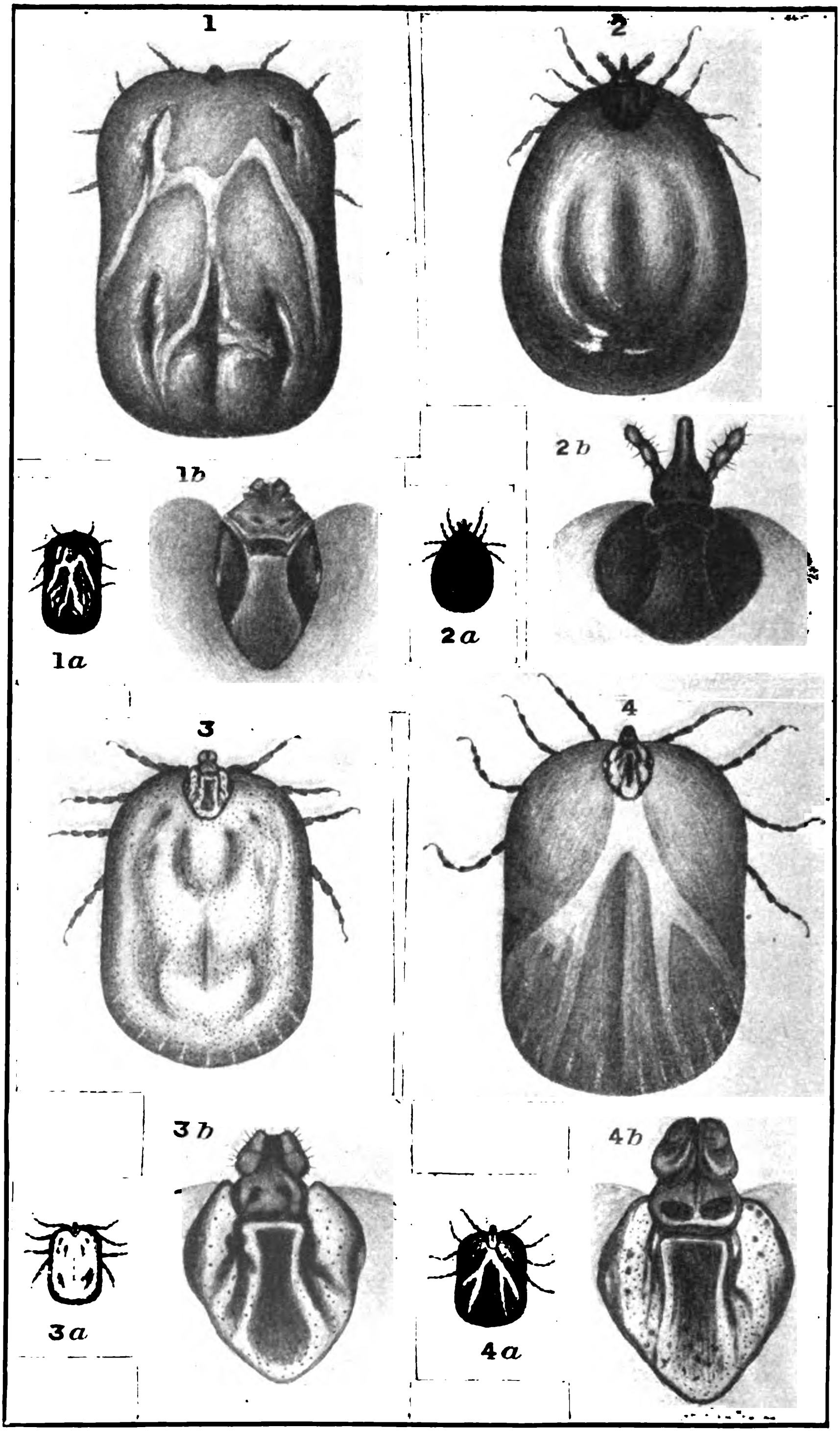

FIG. 3.—Various ticks that infest cattle.

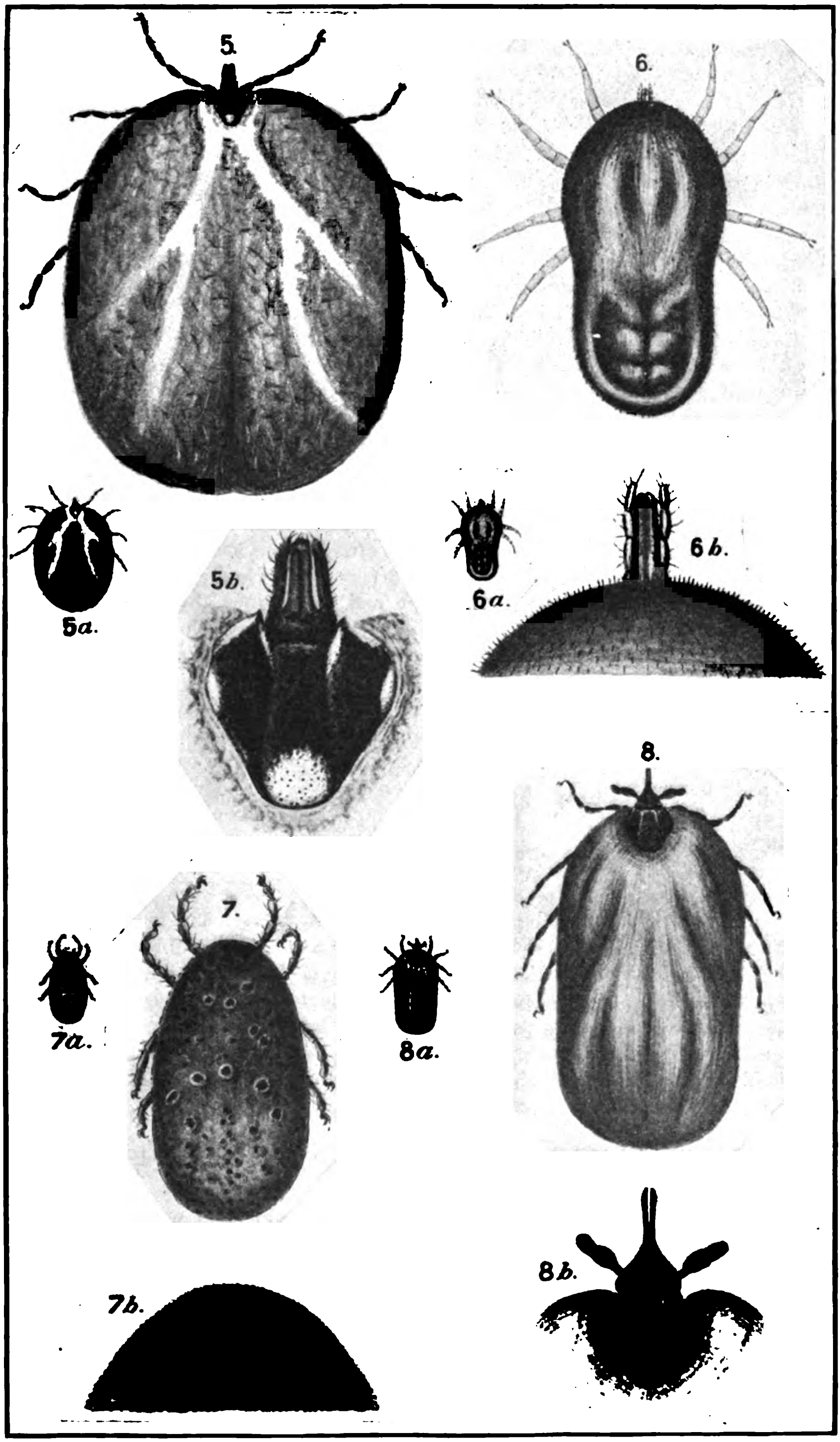

FIG. 4.—Various ticks that infest cattle.

woods and on uncultivated lands in many sections of this country, especially in eastern United States.

Lone Star tick (*Amblyomma americanum*).—As indicated by Nos. 5 and 5a of figure 4, the body of this tick is oblong oval and of a yellowish gray or brown color. The skin is rough and puckered unless the body is full of blood. The reddish-brown area at the front of the tick is composed of the head and head shield. The latter extends backward a short distance to form a triangle, in the apex of which is a white or metallic-yellow spot, from which it derives its name "Lone Star" (No. 5b). The mature female may reach one-half inch in length and has four pairs of long thin legs. This tick has been found on cattle, dogs, horses, sheep, goats, hogs, and man, and is very widely distributed in the United States.

Ear tick (*Ornithodoros megnini*).—As will be observed from Nos. 6 and 6a, figure 4, the shape of this tick is similar to that of the body of a violin. It is nearly twice as long as broad, rounded at both ends, narrower behind than in front, and slightly constricted in the middle. In color it varies from gray or brown to violet, and has two grooves behind the head, with a middle one in the posterior portion. On the skin of the back are numerous minute spines, or stiff hairs. The adult females are from ¼ to ⅜ inch in length, and have four pairs of long stout legs. The anterior portion of the tick is curved downward to form a cover for the very small and short head, which can only be seen from the under side of the tick. The feelers (palpi) and beak, however, stick out from under the front part of the body and can be seen from above (No. 6b). This tick is found in the ears of cattle, horses, mules, asses, and other animals in the South and West.

Chicken tick (*Argas miniatus*).—In shape and appearance this tick is like an enlarged bedbug, and is of a uniform reddish brown color, with four pairs of lighter colored legs. The skin is wrinkled and contains very short and minute hairs. On the top as well as the bottom of the tick are numerous bright pits or cavities with raised borders (fig. 4, Nos. 7 and 7a). These vary in size, are arranged in rows radiating from the center more or less uniformly, and are usually symmetrical on each side. It is about ⅜ inch in size when mature. The head is so completely covered by the body that it can not be seen from the back (No. 7b). This tick has been observed on cattle once only, but is frequently found on chickens, turkeys, and other birds in the South.

European dog tick (*Ixodes hexagonus*).—The body of this tick is oval in shape and of an ashy color (fig. 4, Nos. 8 and 8a). The grooves on the back are united in an arch in front and diverge in the posterior portion of the body. The four pairs of legs are longer, thicker, and stronger than those of the cattle tick. The head and shield are brown-red in color and similar in shape to those of the castor-bean tick, but less oval and rather more lozenge-shaped, with more acute lateral angles and narrower posterior angle (No. 8a). The palpi, or feelers, are longer and more prominent than in the cattle tick, but not so long as in the castor-bean tick. This tick has been collected from dogs, cattle, sheep, foxes, rabbits, squirrels, gophers, cats, birds, man, and other hosts in eastern United States.

SOME APPARENT EXCEPTIONS TO THE TICK AS A CARRIER OF TEXAS FEVER.

TEXAS FEVER IN ANIMALS APPARENTLY NOT INFESTED WITH TICKS.

One objection that has been advanced against the fact that the cattle tick is a carrier of Texas fever is that cattle are sometimes found to be suffering with the disease without showing the presence of the ticks on their bodies. This condition, in the case of southern cattle, may be explained on the hypothesis that the animal already had its blood infected with the microparasites and under normal conditions was immune from Texas fever; however, as a result of lowered vitality caused by some other disease, or by exposure, privation, injury, rough handling, etc., this immunity has become reduced and finally overcome, and the parasite of Texas fever, dealing now with an impoverished condition of the animal, succeeds in producing Texas fever. Since the experiments of the Bureau of Animal Industry show that the blood of an immune animal may contain this microparasite for at least 13 years after removal from all sources of infection, it would appear that this recurrence of disease in immune animals placed under adverse conditions could occur at almost any period of their lives, and may be termed a relapse. Thus it has been frequently noted that southern cattle, born and raised in infected pastures but later freed of ticks and placed on noninfected soil, have died of Texas fever when their health was so weakened as to permit the parasites already infecting the blood to overcome the natural resistance of the body and produce the disease.

Again, in certain dipping experiments where the animals had been roughly handled and unduly exposed after having been dipped in a severely irritating solution, a few deaths occurred from Texas fever among cattle which were known previously to have been immune—tick-infested southern animals—but whose vitality had been reduced through these extraordinary conditions.

On the other hand, when this disease is observed in northern animals, the young seed ticks may be so small and so few in number as to be passed readily by even a careful examination, yet numerous enough to cause the affection. In such cases the proof will be found either by prolonged search or in the fact that other animals subsequently take the disease with larger ticks apparent on the skin.

SOUTHERN CATTLE INFESTED WITH FEVER TICKS MAY DIE OF TEXAS FEVER.

When cows born and raised in the South die of Texas fever, it is proof that such cattle never came in contact with infected cattle ticks before, or that they were raised on tick-free pastures, or that they belong to those cases of immune southern cattle which lose their immunity when subjected to adverse or extraordinary conditions, such as those mentioned above. Otherwise they would have been unsusceptible and would not have developed Texas fever. Southern cattle, when raised and kept in districts free from cattle ticks, fail to secure the natural immunity induced by gradual and constant tick infestation from birth, and they are just as susceptible to the disease as are northern animals. Under certain conditions, as when living on horses, mules, etc., fever ticks lose their infectiousness, and when southern cattle not previously infected with any but these noninfected ticks come in contact with infected ticks they are just as susceptible as cattle raised on tick-free pastures, as indicated below.

HARMLESS TICKS MISTAKEN FOR TEXAS-FEVER TICKS.

A very prolific cause for argument against the relation of ticks to Texas fever has been the confusion which exists with reference to the various species of ticks observed on cattle. Some stockmen have claimed that ticks will not cause Texas fever, because their experience has not been with the Texas-fever ticks, but with the species of ticks described in the preceding pages, which are harmless so far as their ability to transmit Texas fever is concerned, or with the noninfected cattle ticks mentioned below. A similar experience with these harmless ticks upon woodland far removed from cattle and confusing them with cattle ticks have led others to claim that it would be impossible to eradicate the latter from infested pastures. However, their life histories are not parallel, since the cattle ticks demand the blood of cattle or equines in order to mature, while the ear, dog, lone star, and other ticks do not. Thus, if the fever ticks can be separated from these animals for a definite period they will die from lack of a host.

SUSCEPTIBLE ANIMALS HAVING FEVER TICKS WITHOUT TEXAS FEVER.

In rare cases it has been observed that certain Texas-fever ticks do not contain the protozoa of Texas fever, and when such ticks fail to produce disease in susceptible animals some persons have been led to argue that none of this species will transmit the infection. Texas-fever ticks without the virus of Texas fever in their bodies are termed noninfected ticks. They may have lost their infectious property by living on a nonsusceptible animal, such as a horse, mule, ass, or suckling calf, as experiments have shown that a generation of infected ticks on these animals will eliminate the infection from their bodies, and when the next generation of seed ticks is placed on susceptible cattle no disease is produced. These ticks will become reinfected, however, if allowed to infest southern cattle containing the Texas-fever protozoa in their blood. Noninfected fever ticks are so very uncommon that it is necessary to treat all fever ticks as infected and capable of transmitting Texas fever.

FEVER TICKS ON OTHER ANIMALS WITHOUT PRODUCING DISEASE.

The reason that Texas-fever ticks can remain on animals other than cattle without producing the disease is because these animals are not susceptible to Texas fever. Numerous experiments have shown that only bovines contract Texas fever, so it is not difficult to understand why other hosts can be infested with impunity.

OTHER INJURIOUS EFFECTS OF CATTLE TICKS.

Many cattle owners who have always been accustomed to see both ticks and ticky cattle on their farms are unfortunately not inclined to attach much importance to cattle ticks, and, as a rule, through lack of appreciation of their damaging effects, placidly consider them as of little consequence. That ticks may be detrimental to their hosts in several ways has probably not suggested itself to these stockmen, and it therefore seems necessary to emphasize the fact that, in addition to their relation to Texas fever, they may also be injurious to cattle as external parasites. While the power of transmitting Texas fever is undoubtedly the most dangerous property possessed by the cattle tick and is the principal cause for adopting stringent measures in securing its complete eradication, nevertheless there still remain other good reasons for the accomplishment of this achievement. True, a few parasites may remain on cattle indefinitely without causing any noticeable effect, but it is not uncommon to notice bovine animals on pastures with their hides very heavily infested with these pests. In such cases it can readily be seen that the continuous sucking of blood causes more or less impoverishment of the circulation. The cattle must therefore be fed heavier in order to meet the demands of the parasites in addition to the ordinary needs of the animals. This condition, together with the loss of blood, frequently induces an irritable state and evidences of uneasiness commonly known as "tick worry," which results in the loss of energy and in other derangements of the animal's health. It may in some cases become so pronounced, especially in hot weather, that the animal will lose flesh in spite of good pasturing, thereby reducing the vitality and rendering it more susceptible to the inroads of disease. Moreover, if the infestation of ticks is not controlled, the cattle may be so reduced in condition that growth is retarded, and, in the case of young animals, they may never become fully developed, but remain thin, weak, and stunted—a condition that has been termed "tick poverty"—and easily succumb to other diseases as a result of lowered vitality.

In milch cows this debilitating influence of the numerous ticks is shown in a greatly reduced milk supply. This should not appear strange when it is considered that some animals harbor many thousands of these bloodsucking parasites. If these parasites are crushed it will be found that their intestines are completely filled with a dark, thick mass of blood abstracted from the animal host and containing nutriment that should go to the formation of milk and flesh and the laying on of fat. In some rare cases the large number of bites over a limited area of skin may be followed by infection with pus-producing organisms, giving rise to small abscesses which may terminate in ulcers. The discharge from such sores, or in some cases the mere oozing of blood serum through the incision made by the mouth parts of the ticks, keeps the hair moist and matted together, and the laying and hatching of fly eggs in these areas give rise to infestation with destructive maggots, causing ulcers and other complications that require medical treatment.

These statements regarding the secondary injurious effects of cattle ticks also apply to those ticks which have been previously spoken of as harmless in so far as Texas fever is concerned, and, in fact, to all external parasites. Therefore, it is just as important to eradicate the cattle ticks for reasons other than those associated with Texas fever as it is to exterminate lice, fleas, and other vermin. Furthermore, cattle ticks, aside from the losses sustained by their purely parasitic effects, are the greatest menace to the profitable raising and feeding of cattle in the South, because they are an obstacle to cattle traffic between the infected and noninfected districts.

LOSS OCCASIONED BY CATTLE TICKS.

The economic aspect of the tick problem is unquestionably of the greatest practical interest, since the fundamental importance of all the other questions which surround it depends upon the actual money value involved. It would therefore seem advisable to furnish a few statistics showing the financial loss sustained by the country as a result of the presence of this parasite. It is well known that those animals coming from an infected district and sold in the "southern pens" of northern stockyards bring an average of one-fourth to one-half a cent less per pound than the quoted market price. The handicap that is placed on the southern cattle raiser as a result of this decrease in value of his stock will average at the former figure at least $1.50 per head, allowing an individual weight of 600 pounds for all classes of animals, so that the loss on the estimated 705,000 southern cattle, including stock, beef, and dairy animals marketed yearly under these conditions, will sum up a loss of $1,057,500 per annum. Carrying this estimate still further, it will be found that this decreased value reacts and fixes the valuation of all cattle which remain in the infected territory, thereby reducing the assets of the cattle industry of that section by this ratio per head for the four and a half millions of cattle east of the Mississippi River and the eleven millions of cattle west of the Mississippi River, or, all together, the enormous shrinkage in value of $23,250,000 directly chargeable to the cattle tick. This sum, however, should not be considered in determining the yearly devastation caused by the cattle tick, but rather as an unnecessary reduction in the assets of the infected country. This last loss does not include the decrease in flesh and lack of development of southern cattle occasioned by the parasitic life of the ticks from without and by the blood-destroying and enervating properties of the protozoan parasites from within, an additional loss which is so very great that a conservative estimate would place it equal to the loss mentioned, or $23,250,000.

The presence of the tick among the cattle of the South not only lessens the value of the cattle on the hoof but causes the gradings of hides that have been infested with ticks as No. 4 quality. The same hide, if free from tick marks, would grade No. 2. The difference in price between these two grades of hides is 3 cents a pound. As the hide of southern steers weighs about 42 pounds, the presence of the tick in the hide causes a loss in the hide alone of more than $1.26 a hide. It has been shown that the cost of tick eradication is only about 50 cents a head, so that if the counties make a systematic campaign to eradicate the tick, the increase in value of the hide alone would pay for the cost of tick eradication and leave the farmer a net profit of about 76 cents a hide.

The shrinkage in the milk production of cattle harboring many ticks will average about 1 quart per day, and the loss occasioned thereby at 3 cents per quart for the 875,000 ticky dairy cattle out of more than 4,000,000 dairy cattle below the quarantine line would amount to $26,250 per day, or, counting 300 milking days for each cow to the year, $7,875,000 per annum. The damage resulting to the southern purchaser of northern purebred or high-grade cattle is another item of no small moment. About 10 per cent of all such cattle taken South die of Texas fever even after they are immunized by blood inoculations, and about 60 per cent of these cattle succumb to Texas fever when not so treated. Since they are usually very expensive animals and of a highly valued strain of blood, the loss in certain cases is excessive and in others almost irreparable, owing to the possible extinction of some particular type especially selected for the improvement of the herd.

Another instance where it is difficult to figure the injury done by the ticks is in the case of death of nonimmune cattle in the tick-free pastures of the South. Such animals are as susceptible to Texas fever as nonimmune northern cattle, and, inasmuch as there are in many sections only one out of every four farms infested with ticks, the cattle on the remaining farms will in many cases contract Texas fever when exposed to the fever tick. These losses can scarcely be computed, as the death rate depends so much on the season of the year when exposure occurs and on the age of the animal affected. However, the deaths among such cattle are considerable, although this fact is little appreciated or understood by many outside of the infected area. The loss thus occasioned has been estimated at $5,812,500 per annum. And this sum, excessive as it may seem, represents a smaller percentage of loss on the total valuation of neat cattle than has been determined by several of the infected States.

On rare occasions a small outbreak of Texas fever occurs north of the quarantine line as a result of improperly disinfected cars, of unscrupulous dealers breaking the quarantine regulations, or of some accidental condition. Such damage, however, is slight, but should be given consideration in summing up the loss occasioned by the fever tick.

The advertisement which a breeder obtains and the sales which are made by having his stock in the show ring are usually lost to the southern cattle raiser who aspires to display his animals in the North, as they are barred from most of these exhibitions. On the other hand, the southern farmer is not given an opportunity to see and be stimulated by the fine specimens of northern cattle which might be shown at southern stock exhibits for the reason that the danger of contracting Texas fever is too patent to warrant such exposure. The expense incurred by the Government and the various States in enforcing the regulations that apply to the quarantine line reaches about $65,000 per annum.

Another loss which is indirectly sustained by the southern cattle industry through increased freight rates is the cost to the railroad companies of cleaning and disinfecting the cars that carry southern cattle and in providing separate pens for these animals at various locations. This sum may be calculated at not less than $29,000 per annum.

If all the above-mentioned losses are added, it will be found that the Texas-fever tick is responsible for about $40,000,000 of loss annually to the people of the infected country, and that it also lowers the assets of the South by an additional $23,250,000. These figures are not given as accurate in any particular, but they are sufficiently close to indicate that the loss to the quarantined section from the cattle tick is something enormous. Such a series of incumbrances as those recorded could be carried by the cattle industry of no other section of the country but the South, whose excellent pastures, rich soil, and salubrious climate are the only reasons for its ability to overcome such obstacles in meeting the competition of the West. And it is the inherent capacity of the South for greatly increasing its herds and enlarging its pasture lands that makes the actual loss even secondary to the potential loss due to restrictions necessitated by the presence of the cattle tick. This potential loss may be described as the difference between the value of the cattle industry of the South to-day and the extent to which this industry would be increased if farmers and ranchmen were assured that their lands and cattle would not become infested with fever ticks. Could this assurance be given, the beneficial effects would extend over the entire country, because the market of the northern breeder would thereby become greatly extended.

These appalling losses and annual sacrifices of the cattle raisers of the infected district can be entirely effaced, and this at a small proportionate cost; for, with enthusiastic stockmen, satisfactory State legislation, sufficient money, and a trained corps of inspectors, the cattle tick may be exterminated, and every dollar expended in this work will be returned manyfold during each succeeding year.

PERIOD OF DEVELOPMENT OF DISEASE AFTER EXPOSURE TO TICKS.

The length of time elapsing between the exposure of susceptible cattle to the cattle tick and the appearance of Texas fever among them is dependent upon the climate and the development of the ticks. Thus, if any northern animals are placed upon pastures, highways, or in pens, cars, etc., in summer immediately after the premises have been infested with ticks from southern cattle, Texas fever may occur in from 30 to 60 days, as the females that drop from the southern cattle must lay eggs and these must hatch before the northern animal becomes infested with ticks, and thereby inoculated with the disease. In cool weather this period may extend to 90 days, as it takes much longer for the eggs to hatch. Where northern animals are not exposed in an infested pasture until the ticks which fell from the southern cattle have laid eggs and the larvæ, or seed ticks, are already present, the northern cattle will develop symptoms in 13 to 15 days in hot weather. Thus under natural conditions the disease appears in 13 to 90 days after exposure. After the seed ticks become attached to the animal the disease will appear in about 10 days in summer, and after a somewhat longer period in cooler weather. In fact, the disease may occur before the ticks are large enough to be seen without a very careful search. By artificially inoculating a cow under the skin or into a vein with virulent blood the disease may be produced in 3 to 10 days.

SYMPTOMS.

The symptoms of Texas fever present two distinct types, the acute and the chronic, depending upon the time of year the disease makes its appearance and the susceptibility of the animals attacked.

ACUTE TYPE.

In the acute form of the disease the temperature rises within 24 to 48 hours to 107° or 108° F., and the animal rapidly shows signs of being affected with a severe malady. It is depressed, leaves the herd, and lies down or stands off by itself with head lowered, ears dropped, feet drawn together, and back arched from the pain in the liver and kidneys. The muzzle is dry, the appetite lost, and rumination ceases. Constipation is always present during the first stages of the disease, but it frequently gives place later to diarrhea, and the manure is usually heavily stained with bile and in rare cases may be mixed with blood. The number of respirations may rise to from 50 to 90, while the pulse beat varies from 90 to 120 per minute.

The changes which occur in both the urine and blood are extremely important, but the urine will receive first consideration here, as it is more readily examined by the layman than the blood. The peculiarty of the urinary secretion is that it is blood-stained, from which symptom the disease has derived its name of "red water." The protozoa in the circulation break up the red corpuscles, liberating the hemoglobin, which is the coloring matter of the blood. This discoloration of the urine is present in the majority of the acute cases, but it is frequently wanting in the chronic form of the disease. The color varies from a mere pinkish tint to an almost black color, depending on the rapidity of destruction of the red cells and the excretion of the coloring matter through the kidneys into the urine.

The blood also furnishes great assistance in making a diagnosis of suspected Texas fever, and the finding of the intracellular parasite microscopically is conclusive evidence. The blood, as it oozes from a small incision in the skin, is pale and watery, indicative of great reduction in the cellular element, and is readily seen to differ markedly from the normal red blood of healthy animals. Sometimes there is such a lack of blood in the vessels of the skin that a very deep incision has to be made in order to obtain sufficient blood for inspection. It is also at times noted that the power of the blood to coagulate is so reduced that when it once starts to flow it is only after a considerable time—or by applying pressure—that the hemorrhage is stopped. In the majority of cases, however, the tendency of the blood to clot is unaffected.

Cerebral symptoms are noticed in a certain percentage of cases, manifesting themselves in the form of staggering gait, disturbances of vision, or delirium. There is in milch cows a reduction or a complete stopping of the milk secretion. Abortion is also very common in pregnant animals. Death usually occurs within three or four days, and is generally preceded by a marked fall of body temperature to normal or even subnormal a few hours before the fatal termination. In nonfatal cases the temperature falls gradually after the crisis and soon reaches the normal, but recovery is prolonged over weeks and even months, as a great deal of time is required to regenerate the greatly impoverished blood.

CHRONIC TYPE.

The chronic form of the disease appears under natural conditions usually in the late autumn and early winter. It can be produced experimentally, however, by placing a few ticks on the skin of a susceptible animal—a fact of very great importance in the production of immunity against the acute type among northern cattle.

This form shows all the symptoms of the acute type, but in a milder degree. The temperature usually remains about 103° and never exceeds 105° F. There is loss of appetite, stoppage of rumination, constipation, and albumen in the urine. An anemic condition of the blood, as indicated by the pale and bloodless mucous membranes, is also present, but hemoglobin is not usually excreted by the urine, hence the red-water symptom is absent. There is also excessive loss of flesh and, before the end of the attack, the affected animal is greatly emaciated. Although death rarely occurs, the valuation of the animal is much reduced.

RELAPSES.

Following recovery from an acute attack, when the red blood cells have apparently reached their normal number, there has frequently been observed a relapse or recurrence of the disease in the mild, chronic form, accompanying which there is a second period of destruction of the red cells. This follows within three to six weeks after the symptoms of the acute attack have subsided. For a considerable time it was unknown whether this was a relapse of the acute attack or due to reinfection from a second generation of ticks. Smith and Kilborne, however, proved that it could occur as a relapse without the presence of ticks, but it may also in some cases be caused by a second extraneous infection.

APPEARANCE AFTER DEATH.

The post-mortem examination should be made as soon as possible after death, as the carcass of an animal dead of Texas fever undergoes decomposition very rapidly. The skin should always be first examined for the presence of the cattle tick, as the discovery of any of the forms of this parasite on the skin of the escutcheon, thigh, or belly leads at once to a suspicion of the presence of the disease. The skin is usually normal in appearance, no visible alterations being present except possibly the small swellings, minute hemorrhages, and perforations from the bites of the ticks. Upon cutting into the hide and skinning the carcass, a marked lack of blood in the blood vessels of the skin and underlying tissues is observed. Occasionally there may be noted a yellowish jaundiced discoloration of these tissues. This is due to the alteration of the bile-secreting function of the liver, but is by no means present in all cases, being most constant in the acute, rapidly fatal form of the disease.

Probably the most marked pathologic alterations in the disease are found in the liver. This organ is very much enlarged and has a yellowish, mahogany-brown color, due to the bile it contains. This secretion becomes excessive, and minute plugs of congealed bile form in the small bile ducts, thus stopping them and damming the bile in the organ, which produces the yellowish color. This does not occur evenly throughout the organ, and consequently it has a mottled appearance. The gall bladder is usually distended with bile, and its mucous membrane often contains numerous minute hemorrhages or blood-shot spots. The bile is very thick, has the appearance of "chewed grass," and contains numerous firm, irregular flakes. The spleen also shows marked changes. Normally this organ weighs from 1½ to 2½ pounds, but in cases of Texas fever it is enormously enlarged, sometimes reaching four times its normal dimensions. It is very dark at times, due to the enormous accumulation of red cells and hemoglobin within its substance. Upon cutting into it the pulpy tissue will sometimes run out as a semifluid blackish mass, due to the breaking down of its structures.

In death from the acute type of the disease the kidneys are usually found to be very dark in color and congested. The blood vessels are engorged with blood, and there is watery infiltration of the surrounding fatty tissue. In the older, more chronic cases the kidneys are paler and somewhat flabby.

The bladder usually contains a varying quantity of urine, which may or may not be blood stained. The mucous membrane frequently contains a few minute hemorrhages.

No characteristic lesions are found in the stomach, intestines, heart, or the lungs.

COURSE AND TERMINATION OF THE DISEASE.

The course of the disease depends not only upon the time of the year the infection occurs, but also on the age, strength, and susceptibility of the animals attacked. When mature susceptible cattle contract the disease in the hot summer months, death usually occurs within a week—generally three or four days—after the first appearance of symptoms, but it may follow inside of 24 hours.

In the infections of partially immune southern cattle and when nonimmune cattle are infected in the late fall, however, the course of the disease is much more prolonged and covers a period of many weeks or even several months. In this type the continuous fever causes exhaustion, while at the same time the enormous destruction of red blood cells interferes very materially with the nutrition of the patient. As a natural consequence, emaciation becomes marked, and this, together with the poor appetite, leads to a fatal result in some cases. In the majority of cases, however, in spite of the severe alterations of the blood and internal organs, the animals begin after several weeks to show improvement. The temperature becomes normal and there is a tendency toward regeneration. This, however, requires weeks and months, the animals in the meantime appearing weak and thin, having pale mucous membranes. During the recuperative period the animal should by no means be fed excessively, as numerous cases of fatal gastrointestinal disturbances have been reported from overfeeding. The few animals which recover from the acute type of summer are quite likely to have a relapse in the form of the chronic type in the fall.

The mortality in adult susceptible cattle, as the above statements readily show, may vary considerably, and ranges from 90 per cent in the months of July and August to less than 50 per cent in the late autumn and early winter. The prognosis must therefore depend on the time of year the outbreak occurs. In animals under 9 months of age the course of the disease is usually short and the affection seldom fatal, while the death rate among 1-year-old cattle during the hot season is about 25 per cent and less than 10 per cent in the fall and winter. Between 1½ and 2 years of age the mortality is about double that at 1 year.

INFECTIVE CHARACTER.

Texas fever belongs to the group of infectious diseases, and it is a typical example of the few diseases of this class which do not combine the property of being contagious. It is infectious because it is due to the entrance and multiplication of a pathogenic microorganism within the body, but sick animals, in the absence of ticks, can remain in intimate association with healthy susceptible animals indefinitely without transmitting the disease to them, and hence it is not contagious. Furthermore, a cow perfectly healthy in appearance may contain in its blood the Texas-fever protozoan, which, when transmitted to susceptible cattle by the fever tick, will produce the disease. It is certain that the piroplasma are present in varying numbers in the manure and urine of infected animals, and yet susceptible animals have never been known to become affected from grazing over tick-free pastures soiled with excrement from sick animals.

The experiment was made by the Bureau of Animal Industry of polluting a pasture with the blood and spleen of an animal dead of Texas fever and then allowing susceptible cattle to graze in the field for two months, but the animals remained perfectly healthy. Moreover, the feeding of ground-up ticks and virulent blood failed to produce the disease, showing that the digestive tract is proof against the infection.

The disease therefore can be transmitted by three known methods only: (1) By the bite of the cattle tick; (2) by inoculating the blood of sick animals into healthy animals; (3) by inoculating the infected blood of apparently healthy southern cattle into nonimmune cattle.

ANIMALS AFFECTED.

Numerous experiments have been made on various species of animals with highly virulent blood from cattle suffering with Texas fever, but the disease has been produced in bovines only. Among those animals that have failed to develop the disease after inoculation may be mentioned horses, asses, sheep, pigs, dogs, cats, mice, rats, guinea pigs, rabbits, chickens, and pigeons. All bovine animals that have never been exposed to the disease are susceptible to Texas fever, although sucking calves are so resistant as to be practically immune. Adult cattle are the most susceptible, and, if attacked in the summer months, usually die, while in the fall and winter they more frequently recover. Calves under 8 months of age contract the affection in a very mild form, as a result of which they become immune from the disease.

DISEASES MISTAKEN FOR TEXAS FEVER.

The two diseases of cattle which may be confounded with Texas fever are anthrax and blackleg. The following are the main features of Texas fever not found in anthrax: Young ticks are usually found on the hide of the affected animal; if occurring in the uninfected territory, the disease can invariably be traced to the shipment of southern cattle into the locality 30 to 90 days previously; young sucking calves as a rule are not affected, the mucous membranes become extremely pale and jaundiced, while in anthrax they are very red and congested; cattle only are attacked, while anthrax attacks all animals. Upon post-mortem examination in Texas fever the tissues under the skin are very pale, while in anthrax they are congested, with the blood vessels standing out prominently. The blood is thin, pale, and watery, whereas in anthrax it is tarry, black, and incoagulable. The bile is semisolid and contains numerous hard flakes, while in anthrax it is fluid. The spleen is affected quite similarly in both diseases, but the liver in Texas fever is enlarged, yellowish, and mottled from the plugging of the bile ducts, whereas in anthrax the liver, although enlarged, is very dark in color and is congested.

Texas fever can usually be differentiated from blackleg by the fact that the great majority of victims of blackleg are between 6 months and 2 years of age. There is usually a total absence of ticks on the hide in the latter disease, while there are present superficial crackling swellings which on being opened are found to contain gas bubbles with the peculiar odor characteristic of the disease. There is also an absence of blood-stained urine. On post-mortem examination in blackleg the muscular tissues beneath the swollen areas are very dark and soft, with bloody fluid, while the liver, spleen, and kidneys are apparently unaffected.

PREVENTION.

It is generally accepted that if southern cattle are entirely free from that species of tick known as *Margaropus annulatus* they can be allowed to mingle with the most susceptible animals without danger. Furthermore, it has been learned from the study of the life history of the cattle tick and from the fact that this tick infests pastures only transiently, never permanently, and will not mature except upon cattle or equines, that its extermination is possible, and that the disease it causes may be prevented. Therefore, the various methods with these results in view should be directed toward the destruction of ticks on cattle as well as their eradication from the pastures.

The details of these methods of eradication will not be discussed here, as this subject is fully treated in Farmers' Bulletin 498, "Methods of exterminating the Texas-fever tick," which may be obtained free upon application to the Department of Agriculture, Washington, D. C.

IMMUNIZATION OF SUSCEPTIBLE CATTLE.

BY BLOOD INOCULATION.

It is often desirable to ship well-bred cattle into infested districts that they may be used to improve the quality of the native cattle already there. Previous to the discovery of the cause of Texas fever it was found to be well-nigh impossible to introduce purebred cattle from the north into any of the infected regions without suffering great loss—sometimes as high as 90 per cent—within a few months of their arrival at their southern destination. It has now been found practicable to immunize this class of cattle so perfectly that the losses which follow their transportation to a tick-infested region are reduced to a minimum. Young animals 6 to 15 months old should, so far as possible, be selected for this purpose, as they are more readily immunized than adults, are more easily handled, and the dangers which may arise from pregnancy while undergoing the immunizing treatment are thus avoided.

Immunity in these cattle is obtained by introducing the microparasite of the blood into their systems. It may be done by direct artificial inoculation or by placing virulent young ticks upon the animals and allowing them to perform the inoculation in the natural manner. The subcutaneous injection of a small amount of defibrinated virulent blood has been found, by means of prolonged experiment, the preferable method, as the number of microorganisms introduced can be more accurately gauged from the syringe than by allowing the infection to be produced by bites of ticks. Two or three inoculations, if repeated at proper intervals, are accomplished with greater safety to the animal than would be possible by means of a single inoculation. The amount first injected should be small and then gradually increased in the succeeding treatments.

The inoculation always results in a more or less serious attack of Texas fever. Besides having a fever, there is a great diminution of red blood cells, and in about 3 per cent of the cases a fatal termination; but the proportion of deaths resulting from the inoculation is small when compared with the fatalities among untreated animals taken into infested districts. To this number should be added those animals (less than 7 per cent) that do not receive sufficient immunity by this method and which succumb when exposed to infested pastures. Combining these failures it will be seen that by this method of immunization, instead of a loss of 90 per cent among breeding stock taken South more than 90 per cent can be saved. The animals should be carefully nursed through the attack and treated symptomatically.

Immunizing inoculations are now being made by the veterinarians of some of the agricultural experiment stations of the Southern States without cost for the services rendered, a charge being made merely for the actual value of food consumed by the animals and attendants' wages. These veterinarians have also issued station bulletins which describe fully the necessary steps to be taken in securing the blood and injecting it into the animals to be immunized, so that the stock owner can follow the instructions with prospects of getting good results.

This operation is not a difficult one, and excellent results will follow where absolute cleanliness and ordinary care have been used, but undoubtedly the best results will be obtained by those who have thoroughly familiarized themselves with the nature of the disease and are experienced in extracting blood from animals. Two methods are in use and will be described separately. One consists in drawing the blood from the jugular vein of an immune animal and immediately injecting it into the cattle to be immunized. It is comparatively simple, requires few instruments, and can be satisfactorily carried out where a small number of animals are to be immunized and if a suitable immune animal is close at hand. First, select an immune animal which is in good health and which is infested with fever ticks or had them the preceding year. Fasten the animal securely, either by tying, throwing, or by placing in a chute. Clip the hair from a space about 4 inches in diameter over the jugular vein on the upper third of the neck, wash the skin thoroughly with a 5 per cent solution of carbolic acid, and then fasten a strap or rope around the neck below the hairless area and draw it tight in order that the blood in the vein will be stopped, causing distension. With a large hypodermic syringe needle, previously sterilized in a 5 per cent carbolic-acid solution, puncture the vein at a slight angle, directing the point forward. When the needle enters the vein the point can be rotated freely in contrast to the restricted movements if still in the tissues, and the blood will either drop or flow from the opening in the needle. Attach the disinfected syringe to the needle with piston in and gradually draw out the piston until the chamber of the syringe is full of blood, when the needle is withdrawn. From a yearling in fair condition a pint of blood may be taken without harm, while double this quantity may be taken from a 2-year-old, and four or five times as much from a 3-year-old or upward. The blood, before it has had time to clot, is immediately injected into the animals to be immunized and which have been previously tied or restrained, the hair clipped, and the skin disinfected at the seat of injection in the region of the shoulder. Inject then from 1 to 3 c. c., according to the age of the animal, under the skin of each animal until the blood is exhausted. When more animals are to be inoculated than one syringeful will inject, the operation may be repeated in the same manner. The only objection to this method is the possibility of the blood clotting in the syringe, but with practice and promptness this can be easily overcome.

The second method is better suited for the inoculation of a large number of cattle or where the immune animal is at a distance from the cattle to be immunized.

The preliminary steps—the clipping of the hair, disinfection of the skin, placing the rope around the neck to distend the jugular vein, and restraining the animal—are the same as for the first method. In puncturing the vein it is advisable to use a small trocar and cannula after sterilization in a 5 per cent carbolic-acid solution, and, when the vein has been entered, to draw out the trocar, allowing the blood to flow through the cannula attached to a rubber tube into a perfectly clean and sterile vessel containing a 5 per cent solution of citrate of potassium or sodium, to prevent the coagulation of the blood. The amount of citrate solution in the container should be one-twentieth of the quantity of blood which it is desired to collect. After sufficient blood has been drawn for the animals to be injected, a cork is placed in the top of the bottle through which passes a long rubber tubing. At the other end of this tubing is a needle and in the middle is a T joint with a syringe at the stem of the T. By the use of valves at this joint the withdrawal of the syringe piston pulls the blood from the bottle, and the insertion of the piston with closure of the opposite valve ejects the blood from the needle. The citrated blood is inoculated under the disinfected skin of the animals to be immunized, as in the first method. This blood may be kept in a dark cool place for one or more months without deteriorating and may be shipped to other points for use.

The place where this injection is made is immaterial, but for convenience a point just behind the shoulder is usually chosen. The dose and number of injections vary with the individual animals. When a large number of cattle are to be inoculated a special form of syringe devised by Pound, of Queensland, may be used. (See fig. 5.) The syringe is so arranged by means of tubes and valves, that by simply pulling out the piston of the syringe and pushing it in again the correct amount of blood is drawn up from the bottle and injected through the needle into the animal, thus obviating the necessity of continually filling the syringe and measuring out the dose. As a rule, it may be stated that 1 cubic centimeter should be injected into an old animal coming into the infested district, 2 cubic centimeters for a 2-year-old, and 3 cubic centimeters for an animal 9 to 15 months old. It will be observed that, unlike the usual custom of applying treatment, the older animals take less than the young ones, owing to their greater susceptibility to the disease. Where an animal has reacted well to a first injection and shows a very high temperature, great reduction of red blood cells, or other symptoms indicative of reaction, it will not be necessary to repeat the injection, but in those cases where the reaction is slight, a second injection should follow after an interval of 40 days, and, if need be, a third injection after a similar lapse of time, always increasing the size of dose 50 per cent. A thermometer, to indicate the course

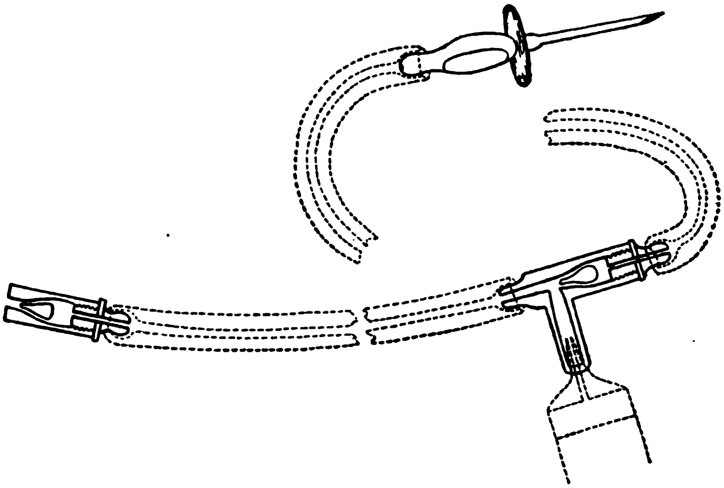

FIG. 5.—Syringe for injecting blood.

and severity of the disease, is indispensable in this work. Usually after 3 to 10 days, sometimes longer, the inoculated animals show a mild type of Texas fever, which runs a course of from 6 to 8 days and is followed in about 30 days after the injection with a second attack of a milder character than the first. After 40 days, when the animal has entirely recovered from the inoculation, a second injection may be given to increase its immunity. In some cases a very severe type of fever follows the first inoculation, requiring careful nursing and symptomatic treatment. A second, milder attack follows usually in about 30 to 40 days, after which the animal need have no further inoculations. It is advisable to prevent any ticks from getting on the cattle until 60 days after their inoculation or until they have fully recovered, at which time a few ticks may be placed upon them in order to reenforce their immunity. Naturally this time varies according to the type of the attack. As the best results with these immunizing experiments have been obtained in cool weather and with young cattle, it is recommended that animals from 6 to 15 months old be selected for inoculation, and that they be immunized during the late fall or winter months, in order that they may enter tick-infested pastures in the spring without danger.

BY INFESTING WITH TICKS.

Immunity may also be induced in susceptible animals by placing a limited number of fever ticks upon their bodies in order to produce the disease naturally. For this purpose only animals less than 1 year of age should be used, as the method is not applicable for older and more susceptible animals. Upon the bodies of these young cattle from 25 to 50 seed ticks should be placed, which in the course of about 10 days will occasion a rise of temperature and a mild form of Texas fever. When the animal has entirely recovered from this attack, a second crop—double the number first used—should be applied to the animal in order to increase its power of resistance when pastured on infested soil. In order to carry out this method successfully a constant supply of seed ticks must be at hand. This can be accomplished by placing the mature females in a Mason fruit jar among some dirt and leaves and keeping them in a warm place. In a few weeks the eggs will have been laid and hatched, and a number of seed ticks will be present for use in infesting the cattle to be immunized. By placing a few adult females in the jar every two months there will always be a supply of these young ticks. This method of producing immunity by controlled tick infestation is not so safe as blood inoculation, since the quantity of germs injected can be more accurately regulated by means of a syringe.

FEDERAL SANITARY REGULATIONS.

The sanitary regulations which have been enacted by the Department of Agriculture for the control of cattle shipments from the infected districts have for their initial purpose the prevention of the transportation of cattle ticks from infected regions to those that are not infected, either upon cattle or in stock cars or other conveyers, during the season of the year when infection is possible. They are based upon the fact that Texas fever is carried north only by the cattle tick; and the exclusion of this parasite from the noninfected territory has in every instance been found a certain method of excluding Texas fever.

The regulations governing the movement of cattle from below the quarantine line are made yearly by the Secretary of Agriculture and they define the boundary of infected districts. In consequence of the enforcement of these quarantine regulations Texas fever has been practically prevented in the noninfected districts during the last several years, and little or no hardship has been caused to those stockmen handling cattle from the infected areas. Previous to their adoption the tick-infested district was rapidly extending northward, but since the quarantine line was established and rational regulations enforced it has gradually been moved farther south.

This problem of still further reducing the infected area is of the greatest importance to the cattlemen of the South—in fact, to those on both sides of the line—and one which is receiving special consideration by this department as well as by all of the interested States.

OTHER IMPORTANT MEASURES FOR REDUCING THE INFECTED AREA.

The first and probably the most important step in eradicating the cattle tick is to start and continue a plan of educating the cattle owner as to the nature of Texas fever and the method of its transmission. This may be best accomplished through farmers' institutes, the issuance of press bulletins and circulars, the publication of short articles in agricultural journals, and, best of all, by personal intercourse between the agricultural population and stock inspectors who are capable of imparting the necessary information. There can be no doubt that the crying need of the infected country is not so much the development of new ideas for exterminating the cattle tick as it is to remove all doubts of stockmen regarding what they term the "tick theory," and to impress upon them the fundamental truths concerning the cattle tick, its relation to Texas fever, and simple methods for its extermination. In some counties within the infected district the local authorities have organized cattle clubs composed of stockmen, with the view of interesting them in exterminating the ticks from their premises, and in preventing cattle in adjoining tick-infested sections from coming upon their property. These organizations are the means of disseminating general information respecting Texas-fever infestation and the cause of the restrictions placed on cattle in the infected district; and through them a concerted action of the cattle owners is obtained, resulting in the control and final eradication of the infection within a portion or the whole of a county. The success of such clubs is a constant reminder of what other organized stockmen could do.

In a number of counties in Virginia, North Carolina, and Georgia, where the laws prohibit cattle from running at large and compel fencing of pastures, the cattle tick soon disappeared, and such tick-free counties were placed above the quarantine line without any loss having followed from the cattle in these districts.

In all the infected States uniform legislation should be secured on the subject of Texas fever, by which these States would be enabled not only to cooperate with the Federal Government, but also with each other. Such laws should prevent the entrance of ticky cattle into the State, unless for slaughter, compel the holding of cattle on inclosed premises, enforce an effectual quarantine on all badly infected areas, make it compulsory to clean up the infection where the ticks are few in number, and stipulate that the stock inspectors appointed for this work must be educated and experienced in the subject of Texas fever.

It is generally admitted that extermination of ticks along the quarantine line is desirable, but the disinfection of pastures within the line is thought by some to be inadvisable. In fact, some writers recommend placing a few ticks on the cattle while young to render them immune when in tick-free pastures. This plan of infecting clean pastures is a questionable proceeding, and if carried out by all below the line would result in producing thousands of ticks where now there are hundreds only. It must be remembered in this connection that the cattle tick is not only the carrier of Texas fever, but is a parasite which deprives its host of much blood, retards growth, reduces the milking capacity, and induces an irritable state known as "tick worry." Even if we exclude its fever-carrying property, it should still be exterminated in all districts, for the same reasons that lice and other vermin are destroyed. Furthermore, cattle may now be rendered immune by blood inoculations, and the necessity for having ticks on the animals for this purpose does not exist. It would therefore seem preferable to keep noninfected farms free from ticks, and if they are in danger of exposure to these parasites make the animals immune by blood injections.

It might be asked, What advantage is it to the stockman below the line to clean his cattle and pastures of ticks unless his animals are permitted to come north without restriction? The greatly improved condition and better development in all respects of such cattle are sufficient answers to this query, and their appearance furnishes a marked contrast to that of those which harbor these parasites.

By the general application of the previously described measures for reducing the infected area, supported by well-directed legislation in all the infected districts, it would become merely a matter of a short period of time before the fever tick would be exterminated and southern cattle permitted to reach the more favorable markets of the North at any time of the year without restraint. Prices would then be higher, the demand greater, and the odium attached to ticky cattle at the stock yards removed. Purebred northern cattle could then be brought into the South to improve the native breed without danger of death from Texas fever, southern animals could enter the show rings of the North without restriction, and the total cost of tick extermination would be far less than the amount saved in the first year after it had been accomplished. However, much cooperation must be had between the farmer and the State and Federal Governments before such a desirable result is possible. And in the meantime, with such conditions attainable, laxity should not be allowed in enforcing the present regulations, national, State, and local, and equal care should be taken to enlighten the stock raisers of the infected district as to the benefits which will follow their thorough understanding of Texas fever and their intelligent assistance in its eradication.

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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 569

TEXAS OR TICK FEVER

INSPECTING AN INTERSTATE SHIPMENT OF CATTLE FOR TICKS

THIS PUBLICATION deals with many questions that arise concerning Texas or tick fever and the eradication of the tick which transmits this disease. The difference between Texas-fever ticks and the harmless ticks often found on cattle and other animals is described and illustrated.

The purpose of the bulletin is to inform livestock owners and the public, especially in the Southern States, regarding the nature of tick fever, the scientific work underlying present methods of eradication, and the benefits to be derived from cooperating with county, State, and Federal authorities in ridding the country of cattle ticks and the disease which they carry.

Washington, D. C.
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TEXAS OR TICK FEVER[1]

By John R. Mohler, *Chief of the Bureau of Animal Industry*

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INTRODUCTION

Texas fever, a very serious obstacle to the cattle industry of the South, has been fairly thoroughly understood since the investigations made by Smith and Kilborne, of the Bureau of Animal Industry. Their work showed conclusively that the cause of the disease was a minute parasite living within the blood cells, the intermediate stage of the development of which occurred in the cattle tick, *Boophilus annulatus*,[2] thus making this tick the indirect but absolutely essential factor in the natural production of the disease. Above the latitude where the cattle tick is destroyed by the cold of winter the disease can be controlled by keeping southern tick-infested cattle from passing through the country during certain seasons. It is also known that by severing the relations of the fever tick and native cattle the former may be exterminated, thus making it possible to eradicate the disease, and thereby to remove a constant menace to the southern cattle breeder, feeder, and dairyman. Especial pains will be taken to make as clear as possible the absolutely proved facts regarding the disease, so that every cattle owner will be able to recognize the malady and to carry out successfully measures for eliminating the tick which causes it.

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[1] This bulletin is a revision of and supersedes Farmers' Bulletin 258. It is of interest to farmers throughout the South.

[2] The American cattle-fever tick has been given various names, including *Ixodes annulatus* Say, 1921; *I. bovis* Riley, 1869; *Boophilus annulatus* Stiles and Hassall, 1901; and *Margaropus annulatus* Hunter, 1908. The preferred name is the one used here *Boophilus annulatus*.

NAME AND SYNONYMS

Of the long list of terms applied to this disease, none seem to fill completely all the requirements of an ideal name. "Texas fever," although the term most commonly in use in this country, is a very misleading one, as it gives to the uninformed the impression that the disease is confined to the State of Texas. Southern cattle fever is especially inapplicable, as the disease is usually more virulent in northern cattle when once infection becomes manifest than in southern cattle. Probably the best name to apply to the disease, since it can be transmitted only in a natural way by the tick, *Boophilus annulatus*, is that of tick fever. This designation, however, is comparatively little used, and, as the disease is generally recognized in this country under the name of Texas fever, this term will be used in the present work. Other synonyms besides those already mentioned are red water, black water, distemper, acclimation fever, murrain, dry murrain, yellow murrain, bloody murrain, Mexican fever, Spanish fever, splenic (or splenetic) fever, protozoan cattle fever, hemaglobinuria, tristeza, paludism of cattle, bovine periodic fever, bovine piroplasmosis, and bovine malaria.

DEFINITION

Texas fever is a specific infectious disease of the blood of cattle, caused by the development and activity of minute animal parasites (Protozoa) which are conveyed to the affected animals by means of the cattle tick, *Boophilus annulatus*. After the microscopic protozoan is injected into the blood of a susceptible animal it attacks the red blood cells, causing them to break down. The disease is characterized by high fever, by destruction of red corpuscles, and the consequent excretion of the coloring matter of the blood by the kidneys, causing a reddish discoloration of the urine, by enlarged spleen, engorged liver, thick, flaky bile, more or less jaundice, emaciation, and death in from 10 per cent of the chronic to 90 per cent of the acute cases. The peculiarity about this disease is that the animals responsible for the spread of the malady are apparently healthy, although containing the Protozoa in their blood, while those that become diseased do not, as a rule, convey the affection to others. In the few instances where they do, it is not by contact, but indirectly by means of the progeny of the ticks from these diseased animals. Infection is not transmitted by the air, urine, saliva, manure, or in any other natural manner than by cattle ticks.

HISTORY

Texas fever was probably introduced into the United States with the importations of cattle by the Spaniards during the early colonization of Mexico and southern United States.

The disease caused continual losses year after year during the early history of this country. It seems to have been described first by Dr. J. Pease toward the close of the eighteenth century. At that time a very severe outbreak of the disease occurred in Lancaster County, Pa., and Pease, after investigating the conditions, claimed it to have been due directly to the shipment of some North Carolina cattle into the State. Experience soon showed that the invariable result following the transportation of southern cattle into the Northern States was the death of all northern cattle along the roads and on the pastures over which the southern cattle had traveled, although the latter animals remained perfectly healthy. In the same way northern cattle taken south almost invariably succumbed to the malady.

These losses prompted the study of the disease by many scientific men, whose investigations soon established the great danger of allowing southern cattle to pass into the Northern States during hot weather, and finally resulted in 1885 in the location of the infected district and the establishment of the Texas-fever quarantine line in 1891 by Dr. D. E. Salmon.

Smith, of the Bureau of Animal Industry, was the first (1889) to recognize and describe as Protoza the intracellular parasites which are the direct causative agents of the disease. In 1889 and 1890 Kilborne, of the same bureau, by conclusive field experiments suggested by Salmon, proved the presence of the cattle tick to be essential in the transmission of the disease. It is of interest to note that this was the first experimental proof furnished on the subject of diseases borne by insects, or diseases that can be carried from one animal to another only by an intermediary host. This mode of transmitting infections has since become familiar to the public by the discovery that certain species of mosquitoes spread malaria and yellow fever to man.

It was suggested by the experiments of the Bureau of Animal Industry in 1892 and 1893 that, through the production of a mild, nonfatal attack of Texas fever in northern cattle, a very considerable degree of protection is afforded against the disease when these cattle are subsequently exposed to the infection on tick-infested pastures.

From 1895 to 1897 additional experiments were conducted by the bureau with the object of further demonstrating the possibility of immunizing cattle against Texas fever by the use of blood obtained from southern cattle; and experiments with a similar object in view were likewise instigated and perfected about this time at the experiment stations of Missouri, Texas, Mississippi, Louisiana, and by the Australian Government, with most excellent results. Later experiments with the disease have been performed principally with the view of obtaining a satisfactory chemical solution in which to dip tick-infested cattle for the purpose of destroying these parasites, and of developing some methods that may be easily carried out for freeing fields, farms, and counties of the cattle tick.

The results obtained in these experiments were so promising that it was believed to be feasible to undertake the complete eradication of the fever tick from the United States and on July 1, 1906, Congress made available an appropriation of $82,500 with which to begin this work. Since that time this project has continued without interruption and gratifying headway has been made in completely freeing large areas of the country from this parasite.

CAUSE OF THE DISEASE

The primary or direct cause of Texas fever is the microparasite *Piroplasma bigeminum*, belonging to the lowest form of animal life, the Protozoa. This minute parasite is found in the blood (fig. 2.[3] No. 5) in every case of Texas

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[3] 1, larva of cattle tick (× 25); 2, same (natural size); 3, mature female and eggs; 4, hide showing cattle ticks; 5, blood cells containing Texas-fever Protozoa (× 1,000); 6, male cattle tick (× 15); 7, same (natural size); 8, young female cattle tick (× 15); 9, same (natural size); 10, various stages of cattle ticks.

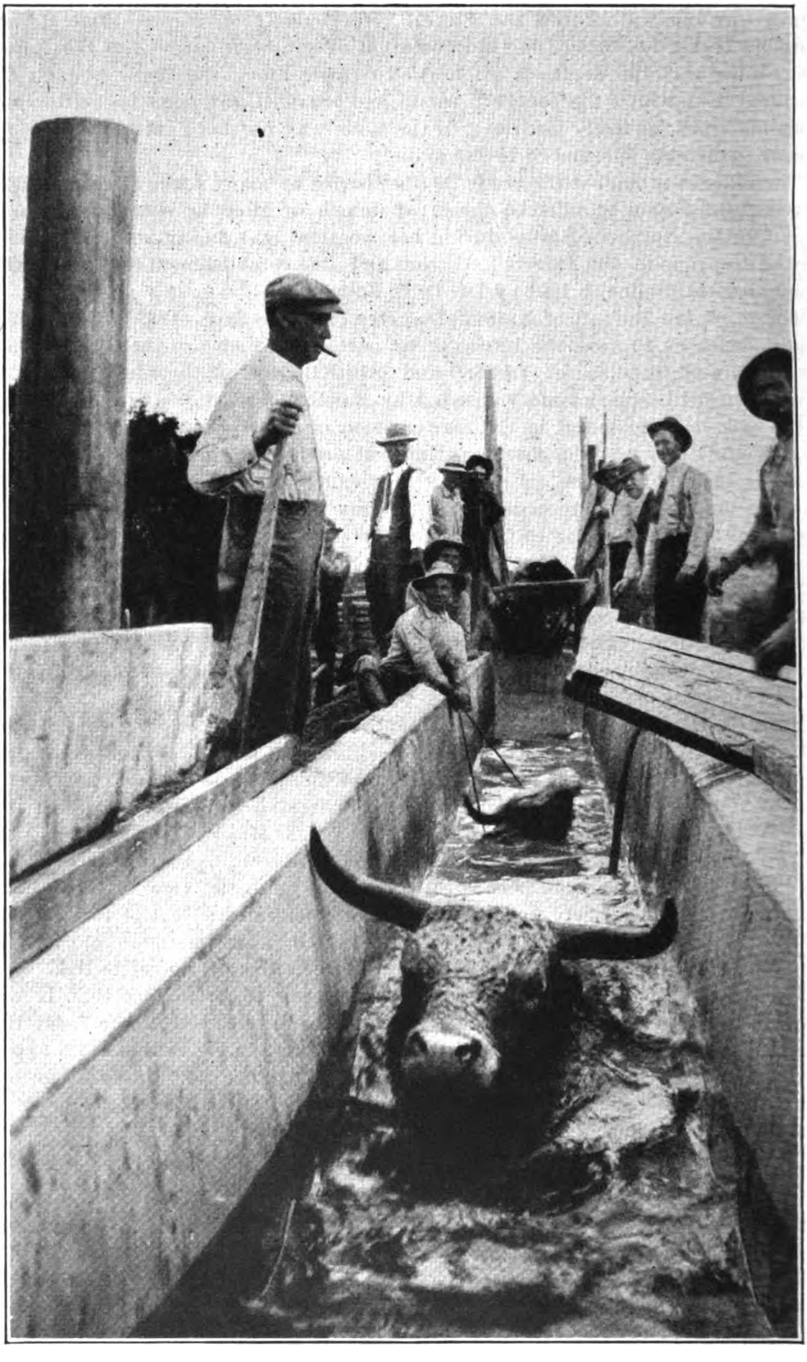

FIG. 1.—Dipping cattle to eradicate ticks. The dipping vat contains a weak arsenical solution, harmless to cattle but fatal to ticks

fever; and by inoculating blood containing it into susceptible cattle, the disease can be invariably transmitted, thus proving its direct causative effect in the production of the malady. After entering into the circulation the Protozoa undergo several stages of development which will not be dwelt on here. The parasites may occupy nearly one-fourth of the body of the red blood cells and, as can be readily understood, exert a detrimental influence upon them. The periphery of these blood cells becomes shriveled or crumpled, and they finally break up, liberating the Piroplasma, which may be observed as free bodies in the circulation—most frequently in the kidneys. The stage of reproduction or multiplication of these Protozoa has never been observed in this laboratory, but that it does occur is proved by the fact that inoculation of a small quantity of virulent blood into susceptible animals will give rise to the disease with myriads of parasites in the blood. The natural path of entrance of these Protozoa, however, is by one channel only, namely, through the bite of the cattle tick. Therefore a knowledge of the habits and life history of the latter is extremely important in controlling the disease, because without this tick Texas fever would be unknown.

LIFE HISTORY OF THE CATTLE TICK AND THE PART PLAYED BY IT IN PRODUCING TEXAS FEVER

In stating the interesting and important life history of this tick, we will start at the point where the fully developed and fertilized female, being engorged with blood and ready to lay her eggs, loosens her hold on the bovine animal and drops to the ground. On reaching the ground she may lie quietly for several days before depositing her eggs. Egg laying may consume from four to eight days in summer and two weeks or even longer in the fall. The number of eggs laid by a fully developed female varies from 1,500 to 3,000, while the immature females also lay eggs, but in much smaller numbers. After laying is finished the female is small and shriveled up and, having fulfilled her mission, soon dies. (Fig. 2, No. 3.) The eggs, which are light brown and waxy in appearance, proceed to develop the larvæ, or seed ticks, the time required for which varies from 13 days to 6 weeks, depending on the conditions of temperature, moisture, soil, etc. These eggs, however, are very tenacious of life, and under unfavorable conditions may remain dormant for several months—from late fall to early spring.

The larvæ, or seed ticks, are minute, six-legged parasites of a brownish, waxy color, and about $\frac{1}{32}$ of an inch in size. (Fig. 2, No. 2.) They crawl actively about on the ground and among leaves, bunching in large numbers on grass blades, shrubs, weeds, and fence posts, to await an opportunity for attachment to their passing host. The parasitism is so perfect that in case no cattle or horses are present no further development occurs, and death finally results. It is known, however, that these larval forms can live for three or four months on the ground in warm weather independent of their host, and from late September until April during an open winter. When they find cattle, however, they fasten themselves to the soft skin inside the thighs and flanks, on the escutcheon, along the belly and brisket, around the root of the tail, and inside the forelegs. (Fig. 2, No. 4.) They obtain their nourishment by drawing blood from the host, and can convey the fever at this stage, although so small as scarcely to be detected by the naked eye. After being on the animal about one week the seed tick casts its covering (molts) and appears as the eight-legged, nymph stage of the parasite, having added one pair of legs posteriorly. During the nymphal stage the sexual organs develop, and at the second molting, from the nymphal to the adult stage, the sexual organs are complete. The male and female at this stage are about the same size, as the female does not become very large until after she becomes fertilized, which occurs about two weeks after the six-legged seed tick reaches its host, or shortly after the second molting. (Fig. 2, Nos. 7 and 9.) After intercourse with the male the female slowly enlarges for 6 to 20 days in summer, and then rapidly increases in size in the course of a day or two before dropping from the animal. In fall and winter development occurs more slowly, the tick not falling off for six weeks or more. After reaching the ground the female soon commences to deposit eggs, thus completing the life cycle, which requires from 6 to 10 weeks in warm weather, or a much longer period during the cold season.

It will thus be seen that these females transmit the infection through their eggs to their progeny, and the latter have the power to infect any susceptible animal to which they attach. The disease, therefore, is not conveyed by the same ticks which take up the infected blood, but only through the generation descending from them.

Although young ticks are very active, neither they nor the adult ticks are capable of crawling very far, but they may be transported long distances by animals, by rains, by winds, cattle cars, hides, and on the clothing of man. Hence the constant danger that tick-free pastures below the quarantine line may become infested with ticks at any time.

HOW TO DISTINGUISH HARMLESS TICKS FOUND ON CATTLE FROM TEXAS-FEVER TICKS

The Texas-fever tick is continually confused with a number of other ticks occasionally found on cattle, which, so far as concerns the transmission of Texas fever, are entirely harmless to them. It is this lack of identification and the inability of many cattle owners to distinguish between these various ticks that have caused so many diverse opinions regarding the important part played by the Texas-fever tick in transmitting Texas fever. In order to differentiate between the ticks that may be found on cattle, a brief description of the upper surface of the maturing or adult female of each is here given, together with illustrations of this view of the ticks, natural size, and also magnified four diameters. It is not thought necessary to describe the male and immature female ticks at this time, inasmuch as these ticks are much smaller in size, and therefore it is more difficult to recognize them by means of the naked eye. Moreover, it is usually possible to secure a maturing female in those instances where a diagnosis is desired, and at this stage of development ticks possess certain characteristic features or markings which should cause them to be classified readily as harmful or harmless even by superficial examination.

There are eight species of ticks which have been found on cattle in this country, but the first six mentioned are by far the most common. They all show the same successive stages of development, namely, eggs, larvæ or seed ticks, nymphs, and adult male and female ticks. Those parts of the adult female tick which will be described below are the head and adjacent shield—which together have erroneously been termed the head parts—and the back of the body, since these portions of the parasite furnish features which to the naked eye are the most readily distinguished by cattle owners. Much stress can not be laid upon the color of these various ticks, as it changes considerably with age.

Texas-fever, or cattle, tick (*Boophilus annulatus*).—Figure 3, 1a, shows the natural size of an adult female Texas-fever tick, whose characteristic markings

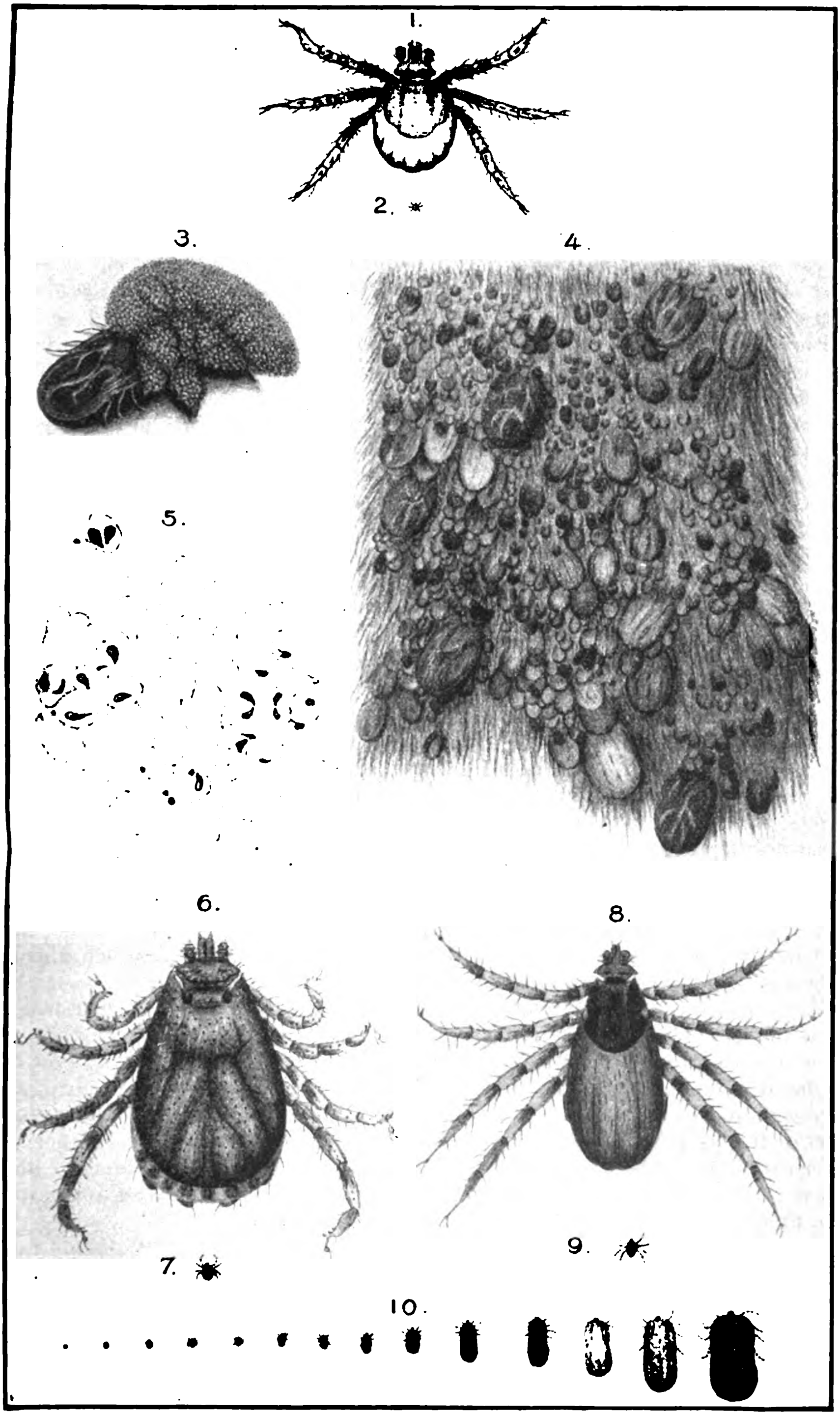

FIG 2.—Texas-fever Protozoa and the ticks which transmit them

are better brought out in No. 1, magnified four times.[4] This tick may be readily distinguished from the other seven ticks by the small size and the color of the head and shield, the so-called head parts, whose lateral borders are straighter and more parallel, as shown in No. 1b. These head parts are short and relatively broad and dark reddish brown or chestnut brown in color. The body is oblong oval in shape and may reach one-half inch in length. The color varies from a dull yellow to an olive brown; often it is mottled with irregular areas of yellow and brown or streaked with wavy lines of these colors. Two grooves or indentations are seen running from the front to the rear on the skin of the back, which become almost, if not entirely, effaced at about the middle of the body. Another groove is seen between these two grooves in the posterior half of the body. These grooves are caused by the contraction of the muscles of the body and therefore vary considerably, entirely disappearing when the tick is full of blood. They are very distinct when the ticks have been removed from cattle several days. The four pairs of legs are brown, moderately long, and very slender. This tick is found principally on cattle, less frequently on horses, mules, and asses, and occasionally it is found on deer.

Castor-bean tick (*Ixodes ricinus*).—The body of this tick (fig. 3, Nos. 2 and 2a) resembles in shape that of an eggplant, and it takes its name from its similarity to the bean of the castor-oil plant. It is lead colored, with a variegated mixture of yellowish red, brown, or gray. The body contains two anterior grooves that slightly diverge from each other, and three posterior grooves, the middle one of which is straight, while the other two are curved outward. The mature female is from three-eighths to seven-sixteenths inch long and has four pairs of dark-brown thin legs. The head and adjacent shield are a shiny dark brown or a chestnut brown, the latter portion being five-sided, like a pentagon (No. 2b), with lateral borders prominent and rear angle rounded. Two stout and well-developed feelers (palpi) may be seen extending outward on each side of the head. This tick has been collected from sheep, cattle, goats, horses, deer, dogs, cats, foxes, rabbits, birds, man, and a few other animals. It was one of the first ticks studied, and has a very wide distribution in the United States.

Winter tick (*Dermacentor albipictus*).—The body of the adult female tick is oblong oval, five-eighths inch long, and of a deep brown or slate color. (Fig. 3, Nos. 3 and 3a.) It has four pairs of brown legs of moderate length. The skin of the back and head is covered with fine points, or punctations, which almost disappear at this stage. Besides the grooves that are located like those in the cattle tick, there is a marginal groove extending around the body just inside the border. There are also 11 small indentations (festoons) arranged about the posterior margin of the body. These festoons and grooves become shallow or effaced in the engorged female. The shield portion of the head parts has a silvery-white metallic rust extending along the two sides and posterior portion (No. 3b.) It may have a rose or greenish tinge. The head is larger than that of the cattle tick. The winter tick has been found on man, cattle, horse, sheep, and deer; and in this country it seems to be the most common in the West, especially in California, Texas, and New Mexico.

American dog tick; also called wood tick (*Dermacentor variabilis*).—This tick (fig. 3, Nos. 4 and 4a) resembles the winter tick (*Dermacentor albipictus*) so closely that a hand lens must be used to distinguish between them. However, it can be readily known from the Texas-fever tick by the fact that the so-called

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[4] In Figures 3 and 4 various ticks that infest cattle are shown as follows: The natural-sized mature female tick, this tick magnified four times, and the head and shield of the same enlarged ten to fifteen times.

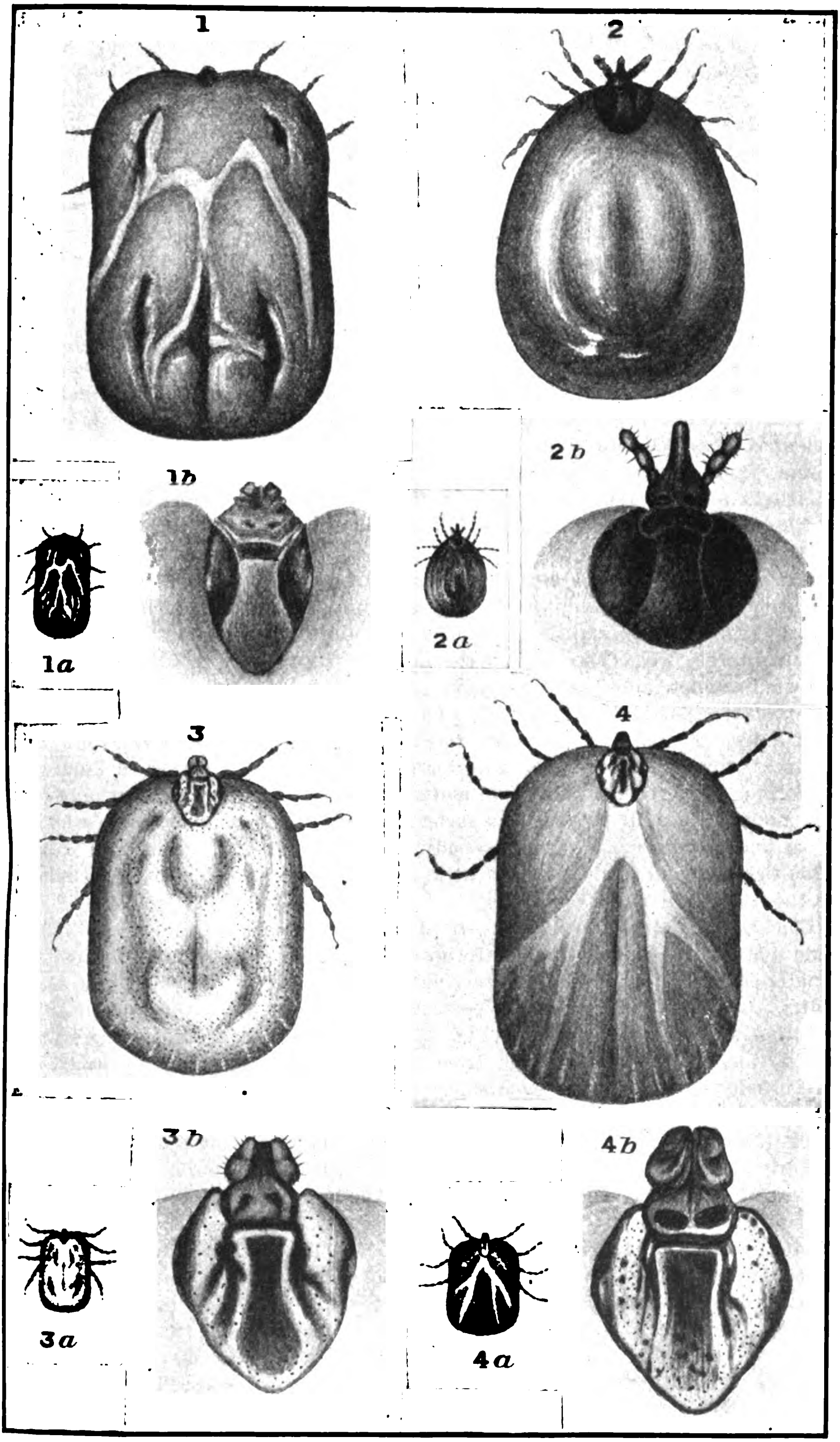

FIG. 3.—Various ticks that infest cattle

head parts are longer and broader (No. 4b). Here there is also a yellowish-white rust in the posterior portion which extends anteriorly along each as two bright, iridescent lines separated by a central brownish area. The body is oblong oval in shape and measures as much as three-fifths inch in length. The skin of the back contains grooves like those found in cattle ticks, and, in addition, another grove extending around just inside the margin, together with 11 smaller grooves (festoons) of the posterior border. These lines, so distinct in the young female, become shallow at maturity. This tick has been found in man, cattle, dogs, horses, rabbits, and panthers, and has been collected in woods and on uncultivated lands in many sections of this country, especially in eastern United States.

Lone Star tick (*Amblyomma americanum*).—As indicated by Nos. 5 and 5a of Figure 4, the body of this tick is oblong oval and of a yellowish. gray or brown color. The skin is rough and puckered unless the body is full of blood. The reddish-brown area at the front of the tick is composed of the head and head shield. The latter extends backward a short distance to form a triangle, in the apex of which is a white or metallic-yellow spot, from which it derives its name "Lone Star" (No. 5b). The mature female may reach one-half inch in length and has four pairs of long, thin legs. This tick has been found on cattle, dogs, horses, sheep, goats, hogs, and man, and is very widely distributed in the United States.

Ear tick (*Ornithodoros mégnini*).—As will be observed from Nos. 6 and 6a, Figure 4, the shape of this tick is similar to that of the body of a violin. It is nearly twice as long as broad, rounded at both ends, narrower behind than in front, and slightly constricted in the middle. In color it varies from gray or brown to violet, and has two grooves behind the head, with a middle one in the posterior portion. On the skin of the back are numerous minute spines or stiff hairs. The adult females are from ¼ to ⅜ inch in length, and have four pairs of long, stout legs. The anterior portion of the tick is curved downward to form a cover for the very small and short head, which can be seen only from the under side of the tick. The feelers (palpi) and beak, however, stick out from under the front part of the body and can be seen from above (No. 6b). This tick is found in the ears of cattle, horses, mules, asses, and other animals in the South and West.

Chicken tick (*Argas miniatus*).—In shape and appearance this tick is like an enlarged bedbug, and is of a uniform, reddish-brown color, with four pairs of lighter-colored legs. The skin is wrinkled and contains very short and minute hairs. On the top as well as the bottom of the tick are numerous bright pits or cavities with raised borders. (Fig. 4, Nos. 7 and 7a.) These vary in size, are arranged in rows radiating from the center, more or less uniformly, and are usually symmetrical on each side. It is about ⅜ inch in size when mature. The head is so completely covered by the body that it can not be seen from the back (No. 7b). This tick has been observed on cattle once only but is frequently found on chicken, turkeys, and other birds in the South.

European dog tick (*Ixodes hexagonus*).—The body of this tick is oval in shape and of an ashy color. (Fig. 4, Nos. 8 and 8a.) The grooves on the back are united in an arch in front and diverge in the posterior portion of the body. The four pairs of legs are longer, thicker, and stronger than those of the cattle tick. The head and shield are brown-red in color and similar in shape to those of the castor-bean tick but less oval and rather more lozenge-shaped, with more acute lateral angles and narrower posterior angle (No. 8a). The palpi, or feelers, are longer and more prominent than in the cattle tick but not so long

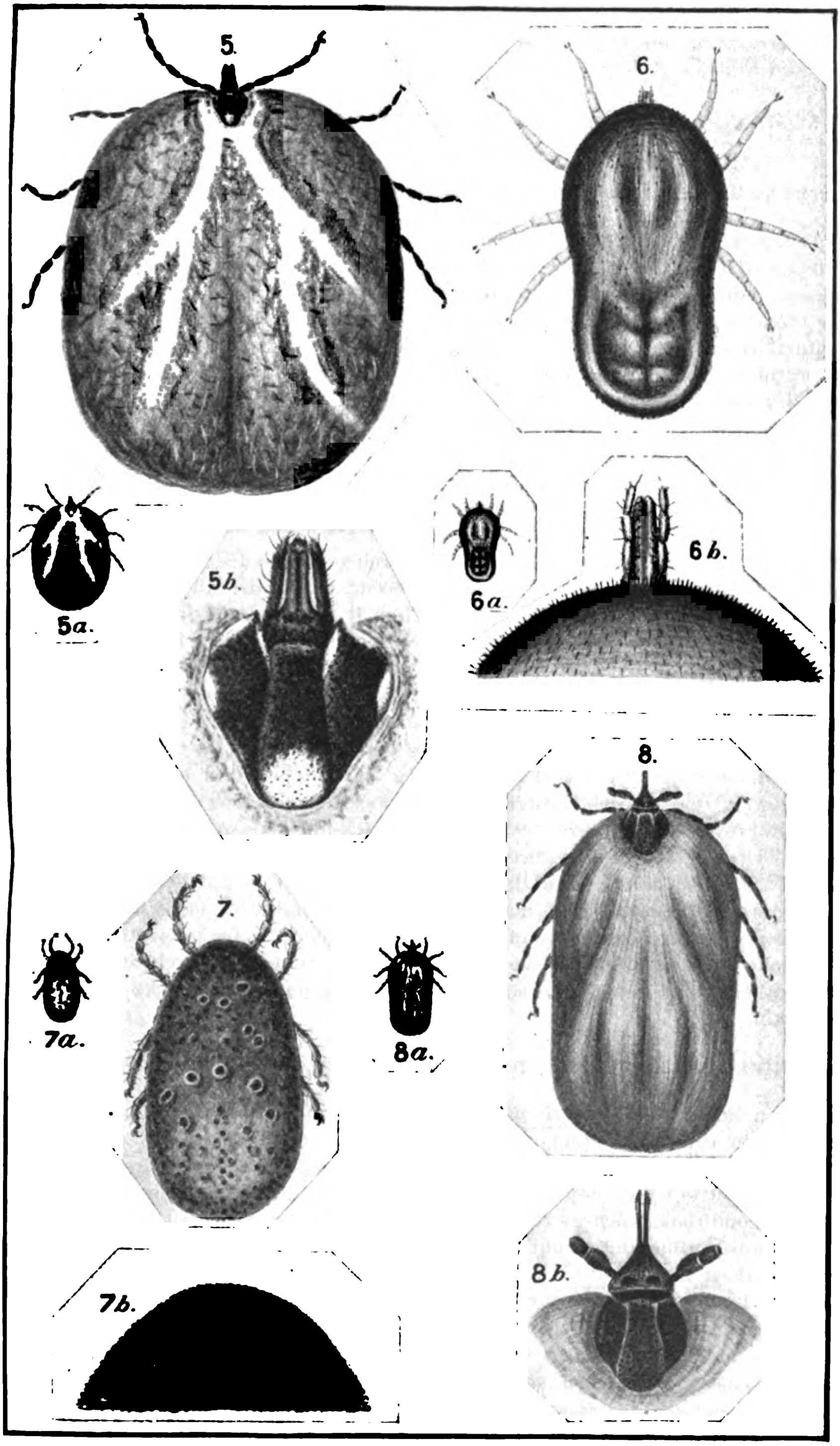

Fig. 4.—Various ticks that infest cattle

as in the castor-bean tick. This tick has been collected from dogs, cattle, sheep, foxes, rabbits, squirrels, gophers, cats, birds, man, and other hosts in eastern United States.

SOME APPARENT EXCEPTIONS TO THE TICK AS A CARRIER OF TEXAS FEVER

TEXAS FEVER IN ANIMALS APPARENTLY NOT INFESTED WITH TICKS

One objection that has been advanced against the fact that the cattle tick is a carrier of Texas fever is that cattle sometimes are found to be suffering with the disease without showing the presence of ticks on their bodies. This condition, in the case of southern cattle, may be explained on the hypothesis that the animal already had its blood infected with the microparasites and under normal conditions was immune from Texas fever; however, as a result of lowered vitality caused by some other diseases, or by exposure, privation, injury, rough handling, etc., this immunity has become reduced and finally overcome, and the parasite of Texas fever, dealing now with an impoverished condition of the animal, succeeds in producing Texas fever. Since the experiments of the Bureau of Animal Industry show that the blood of an immune animal may contain this microparasite for at least 13 years after removal from all sources of infection, it would appear that this recurrence of disease in immune animals placed under adverse conditions could occur at almost any period of their lives, and may be termed a relapse. Thus it has been frequently noted that southern cattle, born and raised in infected pastures but later freed of ticks and placed on noninfected soil, have died of Texas fever when their health was so weakened as to permit the parasites already infecting the blood to overcome the natural resistance of the body and produce the disease.

Again, in certain dipping experiments where the animals had been roughly handled and unduly exposed after having been dipped in a severely irritating solution, a few deaths occurred from Texas fever among cattle which were known previously to have been immune—tick-infested southern animals—but whose vitality had been reduced through these extraordinary conditions.

On the other hand, when this disease is observed in northern animals, the young seed ticks may be so small and so few in number as to be passed readily by even a careful examination, yet numerous enough to cause the affection. In such cases the proof will be found either by prolonged search or in the fact that other animals subsequently take the disease with larger ticks apparent on the skin.

SOUTHERN CATTLE INFESTED WITH FEVER TICKS MAY DIE OF TEXAS FEVER

When cattle born and raised in the South die of Texas fever, it is proof that they never came in contact with infected cattle ticks before, or that they were raised on tick-free pastures, or that they belong to those cases of immune southern cattle which lose their immunity when subjected to adverse or extraordinary conditions, such as those mentioned above. Otherwise they would have been insusceptible and would not have developed Texas fever. Southern cattle, when raised and kept in districts free from cattle ticks, fail to secure the natural immunity induced by gradual and constant tick infestation from birth, and they are just as susceptible to the disease as are northern animals. Under certain conditions, as when living on horses, mules, etc., fever ticks lose their infectiousness, and when southern cattle not previously infected with any but these noninfected ticks come in contact with infected ticks they are just as susceptible as cattle raised on tick-free pastures, as indicated below.

HARMLESS TICKS MISTAKEN FOR TEXAS-FEVER TICKS

A very prolific cause for argument against the relation of ticks to Texas fever has been the confusion which exists with reference to the various species of ticks observed on cattle. Some stockmen have claimed that ticks will not cause Texas fever, because their experience has not been with the Texas-fever ticks, but with the species of ticks described in the preceding pages, which are harmless so far as their ability to transmit Texas fever is concerned, or with the noninfected cattle tick mentioned below. A similar experience with these harmless ticks on woodland far removed from cattle and the false assumption that they were cattle ticks have led others to claim that it would be impossible to eradicate the latter from infested pastures. However, their life histories are not parallel, since the cattle ticks demand the blood of cattle or equines in order to mature, while the ear, dog, lone star, and other ticks do not. Thus, if the fever ticks can be separated from these animals for a definite period they will die from lack of a host.

SUSCEPTIBLE ANIMALS HAVING FEVER TICKS WITHOUT TEXAS FEVER

In rare cases it has been observed that certain Texas-fever ticks do not contain the Protozoa of Texas fever, and when such ticks fail to produce disease in susceptible animals some persons have been led to argue that none of this species will transmit the infection. Texas-fever ticks without the virus of Texas fever in their bodies are termed noninfected ticks. They may have lost their infectious property by living on a nonsuspectible animal, such as a horse, mule, ass, or suckling calf, as experiments have shown that a generation of infected ticks on these animals will eliminate the infection from their bodies, and when the next generation of seed ticks is placed on susceptible cattle no disease is produced. These ticks will become reinfected, however, if allowed to infest southern cattle containing the Texas-fever Protozoa in their blood. Noninfected fever ticks are so very uncommon that it is necessary to treat all fever ticks as infected and capable of transmitting Texas fever.

FEVER TICKS ON OTHER ANIMALS WITHOUT PRODUCING DISEASE

The reason that Texas-fever ticks can remain on animals other than cattle without producing the disease is because these animals are not susceptible to Texas fever. Numerous experiments have shown that only bovines contract Texas fever, so it is not difficult to understand why other hosts can be infested with impunity.

OTHER INJURIOUS EFFECTS OF CATTLE TICKS

Many cattle owners who have always been accustomed to see both ticks and ticky cattle on their farms are unfortunately not inclined to attach much importance to cattle ticks, and as a rule, through lack of appreciation of their damaging effects, placidly consider them as of little consequence. That ticks may be detrimental to their hosts in several ways has probably not suggested itself to these stockmen, and it therefore seems necessary to emphasize the fact that, in addition to their relation to Texas fever, they may also be injurious to cattle as external parasites. While the power of transmitting Texas fever is undoubtedly the most dangerous property possessed by the cattle tick and is the principal cause for adopting stringent measures in securing its complete eradication, nevertheless there still remain other good reasons for the accomplishment of this achievement. True, a few parasites may remain on cattle indefinitely without causing any noticeable effect, but it is not uncommon to notice bovine animals on pastures with their hides very heavily infested with these pests. In such cases it can readily be seen that the continuous sucking of blood causes more or less impoverishment of the circulation. The cattle must therefore be fed more heavily in order to meet the demands of the parasites in addition to the ordinary needs of the animals. This condition, together with the loss of blood, frequently induces an irritable state and evidences of uneasiness commonly known as "tick worry," which results in the loss of energy and in other derangements of the animal's health. It may in some cases become so pronounced, especially in hot weather, that the animal will lose flesh in spite of good pasturing, thereby reducing the vitality and rendering it more susceptible to the inroads of disease. Moreover, if the infestation of ticks is not controlled, the cattle may be so reduced in condition that growth is retarded, and in the case of young animals, they may never become fully developed but remain thin, weak, and stunted—a condition that has been termed "tick poverty"—and easily succumb to other diseases as a result of lowered vitality.

In milk cows this debilitating influence of the numerous ticks is shown in a greatly reduced milk supply. This should not appear strange when it is considered that some animals harbor many thousands of these bloodsucking parasites. If these parasites are crushed it will be found that their intestines are completely filled with a dark, thick mass of blood abstracted from the animal host and containing nutriment that should go to the formation of milk and flesh and the laying on of fat. In some rare cases the large number of bites over a limited area of skin may be followed by infection with pus-producing organisms, giving rise to small abscesses which may terminate in ulcers. The discharge from such sores, or in some cases the mere oozing of blood serum through the incision made by the mouth parts of the ticks, keeps the hair moist and matted together, and the laying and hatching of fly eggs in these areas give rise to infestation with destructive maggots, causing ulcers and other complications that require medical treatment.

These statements regarding the secondary injurious effects of cattle ticks also apply to those ticks which have been previously spoken of as harmless so far as Texas fever is concerned, and in fact to all external parasites. Therefore, it is just as important to eradicate the cattle ticks for reasons other than those associated with Texas fever as it is to exterminate lice, fleas, and other vermin. Furthermore, cattle ticks, aside from the losses sustained by their purely parasitic effects, are the greatest menace to the profitable raising and feeding of cattle in the South, because they are an obstacle to cattle traffic between the infected and noninfected districts.

LOSS OCCASIONED BY CATTLE TICKS

The economic aspect of the tick problem is unquestionably of the greatest practical interest, since the fundamental importance of all the other questions which surround it depends on the actual money value involved. A careful and conservative estimate made in 1906 placed the annual loss caused by the ticks in the United States at $40,000,000 and indicated that the ticks also lowered the assets of the South by an additional $33,000,000. The principal items in these losses are set forth below.

Since May 1, 1928, the interstate shipment of tick-infested cattle for any purpose has been prohibited, making necessary the trouble and expense of dipping and freeing cattle for shipment. Formerly animals coming from an infected district and sold in the southern pens at northern markets brought from one-half to 1½ cents a pound less than the quoted market prices. The handicap that was thus placed on the southern cattle raisers as a result of this decreased value of the stock averaged at this figure from $3 to $9 a head, allowing an individual weight of 600 pounds for all classes of animals. This decreased value reacted and fixed the valuation of all cattle in the infected territory, thereby reducing the assets of the cattle industry of that section. In addition there is a very heavy loss from the decrease in flesh and lack of development of southern cattle occasioned by the parasitic life of the ticks from without and by the blood-destroying and enervating properties of the protozoan parasites within.

The presence of the tick among the cattle of the South not only lessens the value of the cattle on the hoof but causes the gradings of the hides that have been infested with ticks as No. 4 quality. The same hide, if free from tick marks, would grade No. 2. The difference in price between these two grades of hides is from 3 to 5 cents a pound. As the hide of a southern steer weighs about 42 pounds, the presence of the tick causes a loss in the hide alone of from $1.25 to $2.10 a hide. The increase in the value of the hide alone would more than pay the cost of tick eradication.

The shrinkage in milk production of cattle harboring many ticks will average 1 quart a day, which in the aggregate is a heavy loss. The damage resulting to the southern purchaser of northern purebred or high-grade cattle has been another item of no small moment. About 10 per cent of such cattle taken into the South die of tick fever even after they are immunized by blood inoculations, and about 60 per cent of them succumb to tick fever when not so treated. As they are usually expensive animals and of a highly valuable strain of blood the loss in certain cases is excessive and in others almost irreparable, owing to the possible extinction of some particular type especially selected for the improvement of the herd.

Another instance in which it is difficult to figure the injury done by the ticks is in the case of death of nonimmune cattle in the tick-free pastures of the South. Such animals are as susceptible to tick fever as nonimmune northern cattle, and inasmuch as there are in many States numerous tick-free pastures within the quarantined areas the possibilities of loss following exposure to ticks are apparent. These losses can scarcely be computed, as the death rate depends so much on the season of the year when exposure occurs and on the age of the animal affected. However, the deaths among such cattle are considerable, although this fact is little appreciated or understood by many outside the infected area.

On rare occasions a small outbreak of Texas fever occurs north of the quarantine line as a result of improperly disinfected cars, of unscrupulous dealers who break quarantine regulations, or of some accidental condition. Such damage, however, is slight, but should be considered in summing up the loss occasioned by the fever tick. A heavy expense is also incurred by the Government and the States in enforcing the regulations that apply to the quarantine line. Another loss which is indirectly sustained by the southern-cattle industry through increased freight rates is the cost, to the railroad companies, of cleaning and disinfecting the cars that carry ticky cattle.

These statements are sufficient to indicate that the loss to the quarantined section from the cattle tick has been enormous. Such a series of encumbrances as those recorded could be carried by the cattle industry of no other section of the country than the South, whose excellent pastures, rich soil, and salubrious climate are the only reasons for its ability to overcome such obstacles in meeting the competition of the West. And it is the inherent capacity of the South for greatly increasing its herds and enlarging its pasture lands that makes the actual loss even secondary to the potential loss from restrictions necessitated by the presence of the cattle tick.

These appalling losses and annual sacrifices of the cattle raisers of the infected district can be entirely effaced, and at a small proportionate cost; for, with enthusiastic stockmen, satisfactory State legislation, sufficient money, and a corps of trained inspectors, the cattle tick may be exterminated, and every dollar expended in this work will be returned many times during the succeeding years.

PERIOD OF DEVELOPMENT OF DISEASE AFTER EXPOSURE TO TICKS

The length of time elapsing between the exposure of susceptible cattle to the cattle tick and the appearance of Texas fever among them is dependent on the climate and the development of the ticks. Thus, if any northern animals are placed upon pastures, highways, or in pens, cars, etc., in summer immediately after the premises have been infested with ticks from southern cattle, Texas fever may occur in from 30 to 60 days, as the females that drop from the southern cattle must lay eggs and these must hatch before the northern animal becomes infested with ticks and thereby inoculated with the disease. In cool weather this period may extend to 90 days, as it takes much longer for the eggs to hatch. Where northern animals are not exposed in an infested pasture until the ticks which fell from the southern cattle have laid eggs and the larvæ, or seed ticks, are already present, the northern cattle will develop symptoms in 13 to 15 days in hot weather. Thus under natural conditions the disease appears in 13 to 90 days after exposure. After the seed ticks become attached to the animal the disease will appear in about 10 days in summer, and after a somewhat longer period in cooler weather. In fact, the disease may occur before the ticks are large enough to be seen without a very careful search. By artificially inoculating a cow under the skin or into a vein with virulent blood the disease may be produced in 3 to 10 days.

SYMPTOMS

The symptoms of Texas fever present two distinct types, the acute and the chronic, depending on the time of year the disease makes its appearance and the susceptibility of the animals attacked.

ACUTE TYPE

In the acute form of the disease the temperature rises within 24 to 48 hours to 107° or 108° F., and the animal rapidly shows signs of being affected with a severe malady. It is depressed, leaves the herd, and lies down or stands off by itself with head lowered, ears dropped, feet drawn together, and back arched from the pain in the liver and kidneys. The muzzle is dry, the appetite lost, and rumination ceases. Constipation is always present during the first stages of the disease, but it frequently gives place later to diarrhea, and the manure is usually heavily stained with bile and in rare cases may be mixed with blood. The number of respirations may rise to from 50 to 90, while the pulse beat varies from 90 to 120 per minute.

The changes which occur in both the urine and blood are extremely important, but the urine will receive first consideration here, as it is more readily examined by the layman than the blood. The peculiarity of the urinary secretion is that it is bloodstained, from which symptoms the disease has derived its name of "red water." The Protozoa in the circulation break up the red corpuscles, liberating the hemoglobin, which is the coloring matter of the blood. This discoloration of the urine is present in the majority of the acute cases, but it is frequently wanting in the chronic form of the disease. The color varies from a mere pinkish tint to an almost black color, depending on the rapidity of destruction of the red cells and the excretion of the coloring matter through the kidneys into the urine.

The blood also furnishes great assistance in making a diagnosis of suspected Texas fever, and the finding of the intracellular parasite microscopically is conclusive evidence. The blood, as it oozes from a small incision in the skin, is pale and watery, indicative of great reduction in the cellular element, and is readily seen to differ markedly from the normal red blood of healthy animals. Sometimes there is such a lack of blood in the vessels of the skin that a very deep incision has to be made in order to obtain sufficient blood for inspection. It is also at times noted that the power of the blood to coagulate is so reduced that when it once starts to flow it is only after a considerable time—or by applying pressure—that the hemorrhage is stopped. In the majority of cases, however, the tendency of the blood to clot is unaffected.

Cerebral symptoms are noticed in a certain percentage of cases, manifesting themselves in the form of staggering gait, disturbances of vision, or delirium. There is in milk cows a reduction or a complete stopping of the milk secretion. Abortion is also very common in pregnant animals. Death usually occurs within three or four days, and is generally preceded by a marked fall of body temperature to normal or even subnormal a few hours before the fatal termination. In nonfatal cases the temperature falls gradually after the crisis and soon reaches the normal, but recovery is prolonged over weeks and even months, as a great deal of time is required to regenerate the greatly impoverished blood.

CHRONIC TYPE

The chronic form of the disease appears under natural conditions usually in the late autumn and early winter. It can be produced experimentally, however, by placing a few ticks on the skin of a susceptible animal—a fact of very great importance in the production of immunity against the acute type among northern cattle.

This form shows all the symptoms of the acute type, but in a milder degree. The temperature usually remains about 103° and never exceeds 105° F. There is loss of appetite, stoppage of rumination, constipation, and albumin in the urine. An anemic condition of the blood, as indicated by the pale and bloodless mucous membranes, is also present, but hemoglobin is not usually excreted by the urine; hence the redwater symptom is absent. There is also excessive loss of flesh and before the end of the attack, the affected animal is greatly emaciated. Although death rarely occurs, the valuation of the animal is much reduced.

RELAPSES

Following recovery from an acute attack, when the red blood cells have apparently reached their normal number, there has frequently been observed a relapse or recurrence of the disease in the mild, chronic form, accompanying which there is a second period of destruction of the red cells. This follows within three to six weeks after the symptoms of the acute attack have subsided. For a considerable time it was unknown whether this was a relapse of the acute attack or due to reinfection from a second generation of ticks. Smith and Kilborne, however, proved that it could occur as a relapse without the presence of ticks, but that it may also in some cases be caused by a second extraneous infection. In some cases the apparent relapse is probably the occurrence of anaplasmosis following a simultaneous infection with this disease and Texas fever. The fever and other symptoms of anaplasmosis occur after the acute symptoms of Texas fever have subsided.

APPEARANCE AFTER DEATH

The post-mortem examination should be made as soon as possible after death, as the carcass of an animal dead of Texas fever undergoes decomposition very rapidly. The skin should always be first examined for the presence of the cattle tick, as the discovery of any of the forms of this parasite on the skin of the escutcheon, thigh, or belly leads at once to a suspicion of the presence of the disease. The skin is usually normal in appearance, no visible alterations being present except possibly the small swellings, minute hemorrhages, and perforations from the bites of the ticks. Upon cutting into the hide and skinning the carcass a marked lack of blood in the blood vessels of the skin and underlying tissues is observed. Occasionally there may be noted a yellowish, jaundiced discoloration of these tissues. This is due to the alteration of the bile-secreting function of the liver, but is by no means present in all cases, being most constant in the acute, rapidly fatal form of the disease.

Probably the most marked pathologic alterations in the disease are found in the liver. This organ is very much enlarged and has a yellowish, mahogany-brown color, due to the bile it contains. This secretion becomes excessive and minute plugs of congealed bile form in the small bile ducts, thus stopping them and damming the bile in the organ, which produces the yellowish color. This does not occur evenly throughout the organ, and consequently it has a mottled appearance. The gall bladder is usually distended with bile and its mucous membrane often contains numerous minute hemorrhages or bloodshot spots. The bile is very thick, has the appearance of "chewed grass," and contains numerous firm, irregular flakes. The spleen also shows marked changes. Normally this organ weighs from 1½ to 2½ pounds, but in cases of Texas fever it is enormously enlarged, sometimes reaching four times its normal dimensions. It is very dark at times, due to the enormous accumulation of red cells and hemoglobin within its substance. On cutting into it the pulpy tissue will sometimes run out as a semifluid, blackish mass, due to the breaking down of its structures.

In death from the acute type of the disease the kidneys are usually found to be very dark in color and congested. The blood vessels are engorged with blood and there is watery infiltration of the surrounding fatty tissue. In the older, more chronic cases the kidneys are paler and somewhat flabby.

The bladder usually contains a varying quantity of urine, which may or may not be bloodstained. The mucous membrane frequently contains a few minute hemorrhages.

No characteristic lesions are found in the stomach, intestines, heart, or the lungs.

COURSE AND TERMINATION OF THE DISEASE

The course of the disease depends not only on the time of the year the infection occurs, but also on the age, strength, and susceptibility of the animals attacked. When mature, susceptible cattle contract the disease in the hot summer months, death usually occurs within a week—generally three or four days—after the first appearance of symptoms, but it may follow inside of 24 hours.

In the infections of partially immune southern cattle and when nonimmune cattle are infected in the late fall, however, the course of the disease is much more prolonged and covers a period of many weeks or even several months. In this type the continuous fever causes exhaustion, while at the same time the enormous destruction of red blood cells interferes very materially with the nutrition of the patient. As a natural consequence emaciation becomes marked, and this, together with the poor appetite, leads to a fatal result in some cases. In the majority of cases, however, in spite of the severe alterations of the blood and internal organs, the animals begin after several weeks to show improvement. The temperature becomes normal and there is a tendency toward regeneration. This, however, requires weeks and months, the animals in the meantime appearing weak and thin, having pale mucous membranes. During the recuperative period the animal should by no means be fed excessively, as numerous cases of fatal gastrointestinal disturbances have been reported from overfeeding. The few animals which recover from the acute type of summer are quite likely to have a relapse in the form of the chronic type in the fall.

The mortality in adult susceptible cattle, as the statements above readily show, may vary considerably, and ranges from 90 per cent in the months of July and August to less than 50 per cent in the late autumn and early winter. The prognosis must therefore depend on the time of year the outbreak occurs. In animals under 9 months of age the course of the disease is usually short and the affection seldom fatal, while the death rate among 1-year-old cattle during the hot season is about 25 per cent and less than 10 per cent in the fall and winter. Between 1½ and 2 years of age the mortality is about double that at 1 year.

INFECTIVE CHARACTER

Texas fever belongs to the group of infectious diseases, and it is a typical example of the few diseases of this class which do not combine the property of being contagious. It is infectious because it is due to the entrance and multiplication of a pathogenic microorganism within the body, but sick animals, in the absence of ticks, can remain in intimate association with healthy, susceptible animals indefinitely without transmitting the disease to them, and hence it is not contagious. Furthermore, a cow perfectly healthy in appearance may contain in its blood the Texas-fever protozoan, which, when transmitted to susceptible cattle by the fever tick, will produce the disease. It is certain that the piroplasma are present in varying numbers in the manure and urine of infected animals, and yet susceptible animals have never been known to become affected from grazing over tick-free pastures soiled with excrement from sick animals.

The experiment was made by the Bureau of Animal Industry of polluting a pasture with the blood and spleen of an animal dead of Texas fever and then allowing susceptible cattle to graze in the field for two months, but the animals remained perfectly healthy. Moreover, the feeding of ground-up ticks and virulent blood failed to produce the disease, showing that the digestive tract is proof against the infection.

The disease therefore can be transmitted by three known methods only: (1) By the bite of the cattle tick; (2) by inoculating the blood of sick animals into healthy animals; (3) by inoculating the infected blood of apparently healthy southern cattle into nonimmune cattle.

ANIMALS AFFECTED

Numerous experiments have been made on various species of animals with highly virulent blood from cattle suffering with Texas fever, but the disease has been produced in bovines only. Among those animals that have failed to develop the disease after inoculation may be mentioned horses, asses, sheep, pigs, dogs, cats, mice, rats, guinea pigs, rabbits, chickens, and pigeons. All bovine animals that have never been exposed to the disease are susceptible to Texas fever, although sucking calves are so resistant as to be practically immune. Adult cattle are the most susceptible, and, if attacked in the summer months, usually die, while in the fall and winter they more frequently recover. Calves under 8 months of age contract the affection in a very mild form, as a result of which they become immune from the disease.

DISEASES MISTAKEN FOR TEXAS FEVER

The three diseases which may be confounded with Texas fever are anthrax, blackleg, and anaplasmosis. The following are the main features of Texas fever not found in anthrax: Young ticks are usually found on the hide of the affected animal; if occurring in the uninfected territory, the disease can invariably be traced to the shipment of southern cattle into the locality 30 to 90 days previously; young sucking calves as a rule are not affected; the mucous membranes become extremely pale and jaundiced, while in anthrax they are very red and congested; cattle only are attacked, while anthrax attacks all animals. On post-mortem examination in Texas fever the tissues under the skin are very pale, while in anthrax they are congested, with the blood vessels standing out prominently. The blood is thin, pale, and watery, whereas in anthrax it is tarry, black, and incoagulable. The bile is semisolid and contains numerous hard flakes, while in anthrax it is fluid. The spleen is affected somewhat similarly in both diseases, but the liver in Texas fever is enlarged, yellowish, and mottled from the plugging of the bile ducts, whereas in anthrax the liver, although enlarged, is very dark in color and is congested.

Texas fever can usually be differentiated from blackleg by the fact that the great majority of victims of blackleg are between 6 months and 2 years of age. There is usually a total absence of ticks on the hide in the latter disease, while there are present superficial, crackling swellings which on being opened are found to contain gas bubbles with the peculiar odor characteristic of the disease. There is also an absence of bloodstained urine. On post-mortem examination in blackleg the muscular tissues beneath the swollen areas are very dark and soft, with bloody fluid, while the liver, spleen, and kidneys are apparently unaffected.

Anaplasmosis, which in many respects resembles Texas fever, has been recognized in recent years in a number of the Southern and Western States (California, Louisiana, Florida, Oklahoma, Kansas, and Nevada, and it possibly occurs in some others). As in Texas fever, a microparasite in the red blood cells is the causative agent. In certain foreign countries several kinds of ticks, the blue tick (*Boophilus decoloratus*), the black tick (*Rhipicephalus simus*), the tropical cattle tick (*Boophilus australis*), and the castor-bean tick (*Ixodes ricinus*) have been shown to be capable of transmitting the infection. Apparently the American Texas-fever tick carries the disease within the Texas-fever area, but the transmission of uncomplicated cases of anaplasmosis by this tick has not yet been experimentally demonstrated in this country, and it is evident that the transmission of the disease outside of this tick area is not due to the cattle-fever tick.

In the United States anaplasmosis has been found in tick-free sections, and the manner of spreading the disease is not definitely known. The course of the affection is usually acute and the mortality from 20 to 60 per cent. The symptoms consist in suppression of the milk flow, loss of appetite, marked weakness, stiff gait with a tendency to lie down frequently, and often a high fever. There is usually a decided constipation, but at times a diarrhea. The urine is generally normal in appearance, not blood-tinged as in Texas fever. The pulse is rather rapid, and likewise the breathing, which is accomplished with grunting sounds. The membranes of the mouth and eyes are very pale and may have a marked jaundiced appearance. There is always a considerable falling off in condition, the affected animal having a very gaunt appearance. Death may occur in from a few days to a week or more after the animal gets down. Many cases recover, but it is usually several months before such animals regain their normal condition. On post-mortem examination there is found a marked spotting of the heart, heart sac, and inner surface of the chest walls with small hemorrhages. The liver is usually enlarged and the gall bladder distended with thick bile. The spleen is greatly enlarged, softened, and dark colored. The white tissues of the body may have a yellowish cast. The blood is thin and watery and under the microscope shows the small dot-like microparasite, *Anaplasma marginale*, in the red blood cells.

PREVENTION

It is generally accepted that if southern cattle are entirely free from that species of tick known as *Boophilus annulatus* they can be allowed to mingle with the most susceptible animals without danger. Furthermore, it has been learned from the study of the life history of the cattle tick and from the fact that this tick infests pastures only transiently, never permanently, and will not mature except upon cattle or equines, that its extermination is possible, and that the disease it causes may be prevented. Therefore the various methods with these results in view should be directed toward the destruction of ticks on cattle as well as their eradication from the pastures.

The details of these methods of eradication will not be discussed here, as this subject is fully treated in Farmers' Bulletin 1057, Cattle-Fever Ticks and Methods of Eradication, which may be obtained free upon application to the Department of Agriculture, Washington, D. C.

IMMUNIZATION OF SUSCEPTIBLE CATTLE

BY BLOOD INOCULATION

Medical treatment of animals sick with tick fever has usually been unsatisfactory. In the United States it is generally believed that this disease will be satisfactorily and finally disposed of only with the complete eradication of the cattle tick and all official work since 1906 has been with this end in view. However, it is sometimes desirable to export to tick-infested countries or ship well-bred cattle into infested districts that they may be used to improve the quality of the native cattle already there. Before the discovery of the cause of Texas fever it was found to be well-nigh impossible to introduce purebred cattle from the North into any of the infected regions without suffering great loss—sometimes as high as 90 per cent—within a few months of their arrival at their southern destination. It has now been found practicable to immunize this class of cattle so perfectly that the losses which follow their transportation to a tick-infested region are reduced to a minimum. Young animals 6 to 15 months old should, so far as possible, be selected for this purpose, as they are more readily immunized than adults, are more easily handled, and the dangers which may arise from pregnancy while undergoing the immunizing treatment are thus avoided.

Immunity in these cattle is obtained by introducing the microparasite of the blood into their systems. It may be done by direct artificial inoculation or by placing virulent young ticks upon the animals and allowing them to perform the inoculation in the natural manner. The subcutaneous injection of a small amount of defibrinated, virulent blood has been found, by means of prolonged experiment, the preferable method, as the number of microorganisms introduced can be more accurately gauged from the syringe than by allowing the infection to be produced by bites of ticks. Two or three inoculations, if repeated at proper intervals, are accomplished with greater safety to the animal than would be possible by means of a single inoculation. The amount first injected should be small and then gradually increased in the succeeding treatments.

The inoculation always results in a more or less serious attack of Texas fever. Besides having a fever, there is a great diminution of red blood cells, and in about 3 per cent of the cases a fatal termination; but the proportion of deaths resulting from the inoculation is small when compared with the fatalities among untreated animals taken into infested districts. To this number should be added those animals (less than 7 per cent) that do not receive sufficient immunity by this method and which succumb when exposed to infested pastures. Combining these failures it will be seen that by this method of immunization, instead of a loss of 90 per cent among breeding stock taken South more than 90 per cent can be saved. The animals should be carefully nursed through the attack and treated symptomatically. The intravenous injection of 100 to 200 cubic centimeters of a 1 per cent solution of trypan blue will be found beneficial in these cases, as it serves to control the severe reaction and to reduce the loss from immunization.

Immunizing inoculations are now being made by the veterinarians of some of the agricultural experiment stations of the Southern States without cost for the services rendered, a charge being made merely for the actual value of feed consumed by the animals and attendants' wages. These veterinarians have also issued station bulletins which describe fully the necessary steps to be taken in securing the blood and injecting it into the animals to be immunized, so that the stock owner can follow the instructions with prospects of getting good results.

This operation is not a difficult one, and excellent results will follow where absolute cleanliness and ordinary care have been used, but undoubtedly the best results will be obtained by those who have thoroughly familiarized themselves with the nature of the disease and are experienced in extracting blood from animals. Two methods are in use and will be described separately. One consists in drawing the blood from the jugular vein of an immune animal and immediately injecting it into the cattle to be immunized. It is comparatively simple, requires few instruments, and can be satisfactorily carried out where a small number of animals are to be immunized and if a suitable immune animal is close at hand. First, select an immune animal which is in good health and which is infested with fever ticks or had them the preceding year. Fasten the animal securely, either by tying, throwing, or by placing in a chute. Clip the hair from a space about 4 inches in diameter over the jugular vein on the upper third of the neck, wash the skin thoroughly with a 5 per cent solution of carbolic acid, and then fasten a strap or rope around the neck below the hairless area and draw it tight in order that the blood in the vein will be stopped, causing distension. With a large hypodermic syringe needle, previously sterilized in a 5 per cent carbolic-acid solution, puncture the vein at a slight angle, directing the point forward. When the needle enters the vein the point can be rotated freely in contrast to the restricted movements if still in the tissues, and the blood will either drop or flow from the opening in the needle. Attach the disinfected syringe to the needle with piston in and gradually draw out the piston until the chamber of the syringe is full of blood, when the needle is withdrawn. From a yearling in fair condition a pint of blood may be taken without harm, while double this quantity may be taken from a 2-year-old, and four or five times as much from a 3-year-old or upward. The blood, before it has had time to clot, is immediately injected into the animals to be immunized and which have been previously tied or restrained, the hair clipped, and the skin disinfected at the seat of injection in the region of the shoulder. Inject then from 1 to 3 cubic centimeters, according to the age of the animal, under the skin of each animal until the blood is exhausted. When more animals are to be inoculated than one syringeful will inject, the operation may be repeated in the same manner. The only objection to this method is the possibility that the blood will clot in the syringe, but with practice and promptness this can be easily overcome.

The second method is better suited for the inoculation of a large number of cattle or where the immune animal is at a distance from the cattle to be immunized.

The preliminary steps—the clipping of the hair, disinfection of the skin, placing the rope around the neck to distend the jugular vein, and restraining the animal—are the same as for the first method. In puncturing the vein it is advisable to use a small trocar and cannula after sterilization in a 5 per cent carbolic-acid solution, and, when the vein has been entered, to draw out the trocar, allowing the blood to flow through the cannula attached to a rubber tube into a perfectly clean and sterile vessel containing a 5 per cent solution of citrate of potassium or sodium, to prevent the coagulation of the blood. The amount of citrate solution in the container should be one-twentieth of the quantity of blood which it is desired to collect. After sufficient blood has been drawn for the animals to be injected, a cork is placed in the top of the bottle, through which passes a long rubber tubing. At the other end of this tubing is a needle, and in the middle is a T joint with a syringe at the stem of the T. By the use of valves at this joint the withdrawal of the syringe piston pulls the blood from the bottle, and the insertion of the piston with closure of the opposite valve ejects the blood from the needle. The citrated blood is inoculated under the disinfected skin of the animals to be immunized as in the first method. This blood may be kept in a dark, cool place for one or more months without deteriorating and may be shipped to other points for use.

The place where this injection is made is immaterial, but for convenience a point just behind the shoulder is usually chosen. The dose and number of injections vary with the individual animals. When a large number of cattle are to be inoculated a special form of syringe devised by Pound, of Queensland, may be used. (See fig. 5.) The syringe is so arranged by means of tubes and valves that by simply pulling out the piston of the syringe and pushing it in again the correct amount of blood is drawn up from the bottle and injected through the needle into the animal, thus obviating the necessity of continually filling the syringe and measuring out the dose. As a rule, it may be stated that 1 cubic centimeter should be injected into an old animal coming into the infested district, 2 cubic centimeters for a 2-year-old, and 3 cubic centimeters for an animal 9 to 15 months old. It will be observed that, unlike the usual custom of applying treatment, the older animals take less than the young ones, owing to their greater susceptibility to the disease. Where an animal has reacted well to a first injection and shows a very high temperature, great reduction of red blood cells, or other symptoms indicative of reaction, it will not be necessary to repeat the injection; but in those cases where the reaction is slight a second injection should follow after an interval of 40 days, and, if need be, a third injection after a similar lapse of time, always increasing the size of dose 50 per cent. A thermometer, to indicate the course and severity of the disease, is indispensable in this work. Usually after 3 to 10 days, sometimes longer, the inoculated animals show a mild type of Texas fever, which runs a course of from 6 to 8 days and is followed in about 30 days after the injection with a second attack of a milder character than the first. After 40 days, when the animal has entirely recovered from the inoculation, a second injection may be given to increase its immunity. In some cases a very severe type of fever follows the first inoculation, requiring careful nursing, symptomatic treatment, and the intravenous injection of 100 to 200 cubic centimeters of a 1 per cent solution of trypan blue. A second, milder attack follows, usually in about 30 to 40 days, after which the animal need have no further inoculations. It is advisable to prevent any ticks from getting on the cattle until 60 days after their inoculation or until they have fully recovered, at which time a few ticks may be placed upon them in order to reenforce their immunity. Naturally, this time varies according to the type of the attack. As the best results with these immunizing experiments have been obtained in cool weather and with young cattle, it is recommended that animals from 6 to 15 months old be selected for inoculation, and that they be immunized during the late fall or winter months in order that they may enter tick-infested pastures in the spring without danger.

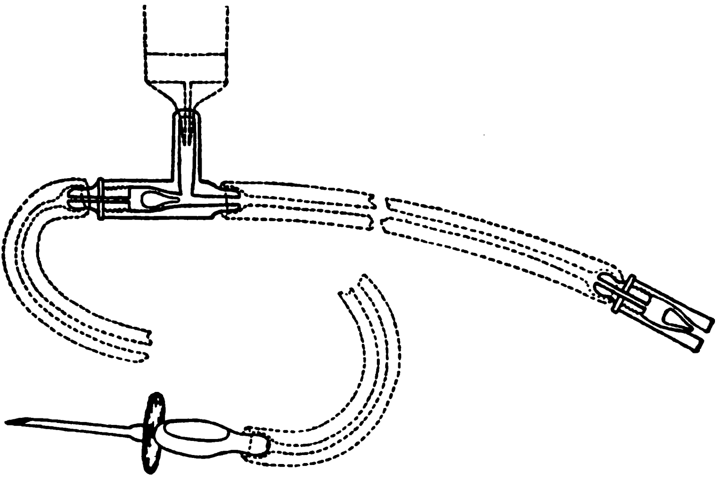

FIG. 5.—Syringe for injecting blood

BY INFESTING WITH TICKS

Immunity may also be induced in susceptible animals by placing a limited number of fever ticks upon their bodies in order to produce the disease naturally. For this purpose only animals less than 1 year of age should be used, as the method is not applicable for older and more susceptible animals. On the bodies of these young cattle from 25 to 50 seed ticks should be placed, which in the course of about 10 days will occasion a rise of temperature and a mild form of Texas fever. When the animal has entirely recovered from this attack, a second crop—double the number first used—should be applied to the animal in order to increase its power of resistance when pastured on infested soil. In order to carry out this method successfully a constant supply of seed ticks must be at hand. This can be accomplished by placing the mature females in a Mason fruit jar among some dirt and leaves and keeping them in a warm place. In a few weeks the eggs will have been laid and hatched, and a number of seed ticks will be present for use in infesting the cattle to be immunized. By placing a few adult females in the jar every two months there will always be a supply of these young ticks. This method of producing immunity by controlled tick infestation is not so safe as blood inoculation, since the quantity of germs injected can be more accurately regulated by means of a syringe.

FEDERAL SANITARY REGULATIONS

The sanitary regulations which have been made by the Department of Agriculture for the control of cattle shipments from the infected districts have for their initial purpose the prevention of the transportation of cattle ticks from infested regions to those that are not infested, whether on cattle or in stock cars or other conveyors. They are based on the fact that tick fever is carried only by the cattle tick; and the exclusion of this parasite from the noninfected territory has in every instance been found a certain method of excluding tick fever.

The regulations define the boundaries of the infected districts and prescribe the treatment required to render cattle tick free and safe for movement from these infested areas. In consequence of the enforcement of these quarantine regulations tick fever has been practically prevented in the noninfected districts during recent years, and little or no hardship has been caused to the stockmen handling cattle from the infected areas. Before the regulations were established the tick-infested district was rapidly extending northward, but since the quarantine line was established and rational regulations enforced in conjunction with the systematic tick-eradication campaign the quarantined area has been reduced to one-fourth of its original size. This problem of still further reducing the infected area is of the greatest importance to the cattle industry of the South, in fact, to the whole country, and one which is receiving special consideration by this department as well as by all of the interested States.

OTHER IMPORTANT MEASURES FOR REDUCING THE INFECTED AREA

The first and probably the most important step in eradicating the cattle tick is to start and continue a plan of educating the cattle owner as to the nature of Texas fever and the method of its transmission. This may be best accomplished through farmers' institutes, the issuance of press bulletins and circulars, the publication of short articles in agricultural journals, and, best of all, by personal intercourse between the agricultural population and stock inspectors who are capable of imparting the necessary information. There can be no doubt that the crying need of the infected country is not so much the development of new ideas for exterminating the cattle tick as it is to remove all doubts of stockmen regarding what they term the "tick theory," and to impress upon them the fundamental truths concerning the cattle tick, its relation to Texas fever, and simple methods for its extermination. In some counties within the infected district the local authorities have organized cattle clubs composed of stockmen, with the view of interesting them in exterminating the ticks from their premises and in preventing cattle in adjoining tick-infested sections from coming upon their property. These organizations are the means of disseminating general information respecting Texas-fever infestation and the cause of the restrictions placed on cattle in the infected district, and through them a concerted action of the cattle owners is obtained, resulting in the control and final eradication of the infection within a portion or the whole of a county. The success of such clubs is a constant reminder of what other organized stockmen could do.

In all the infected States uniform legislation should be secured on the subject of Texas fever by which these States would be enabled not only to cooperate with the Federal Government, but also with each other. Such laws should prevent the entrance of ticky cattle into the State, compel the holding of cattle on inclosed premises, enforce an effectual quarantine on all badly infected areas, make it compulsory to clean up the infection, and stipulate that the stock inspectors appointed for this work must be educated and experienced in the subject of Texas fever.

By the general application of the previously described measures for reducing the infected area, supported by well-directed legislation in all infected districts, it would become merely a matter of a short period of time before the fever tick would be exterminated and southern cattle permitted to reach the markets of the North without restraint, thus supplying the increasing demand of the Northern States for grazers and feeders. Prices would then be higher, the demand greater, and the odium attached to ticky cattle at the stockyards removed. Purebred northern cattle could then be brought into the South to improve the native breed without danger of death from Texas fever, southern animals could enter the show rings of the North without restriction, and the total cost of tick extermination would be far less than the amount saved in the first year after it had been accomplished. However, much cooperation must be had between the farmer and the State and Federal Governments before such a desirable result is possible. And in the meantime, with such conditions attainable, laxity should not be allowed in enforcing the present regulations, national, State, and local, and equal care should be taken to enlighten the stock raisers of the infected district as to the benefits which will follow their thorough understanding of Texas fever and their intelligent assistance in its eradication.

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U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

570

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THE AGRICULTURAL OUTLOOK.

INTRODUCTION.

The figures given in this bulletin are all estimates, but are believed to be the best obtainable. The estimates of production of the different crops and the prices of same on farms are based on reports from five independent sources of information, namely, (1) approximately 30,000 township correspondents, (2) approximately 2,800 county correspondents, (3) 45 State statistical agents, (4) 19 special field agents, and (5) approximately 111,700 aids reporting to the State and special field agents, individual farmers, and special correspondents, or a total of approximately 144,564. Estimates from these sources are received monthly at the Washington office, where they are tabulated and the totals by crops and by States are passed upon by a Crop Reporting Board which is composed of four bureau officials, two special field agents, and an advisory member from the Bureau of the Census. The members of this board base their estimate of what the total crop production will be upon the data obtained from the sources named, their judgment and experience as to the relative value of each source, the history of the crop during the present season, the weather conditions as reported by the Weather Bureau, and such other information as may be obtained from State and commercial organizations, daily market reports of quantities received and sold, and prices quoted at principal markets. The final estimates of the Crop Reporting Board are also checked, so far as practicable, against the totals reported by State assessors and against the statistics of acreages, production, and values published by the Bureau of the Census. Estimates of farm prices are averages of reports from a large number of regular correspondents, who base their reports upon actual sales at local markets and shipping points.

The estimated total production and value of farm crops and live stock, when assembled for the whole United States, is so large that if allowed to stand alone without explanation it is apt to be misleading. To be of value, the totals showing such enormous production of wealth must be considered in connection with the amount of capital invested, the cost of production, and the number of adults employed and living on farms. In round numbers, it is estimated that the total farm value of all crops for 1913 is $6,100,000,000. The total farm value of animals sold and slaughtered and of animal products is $3,650,000,000, making an estimated total of the gross value of farm products in 1913 amounting to $9,750,000,000.

It is roughly estimated that of the 1913 crop, valued at $6,100,000,000, approximately 52 per cent will never be sold, but will remain on the farms where it was produced, leaving only 48 per cent which will be sold for cash. This will reduce the estimated cash sales of farm crops to $2,929,000,000.

Of the total animal products, valued at $3,650,000,000, it is estimated that 20 per cent will be consumed on the farm and that approximately 80 per cent will represent cash sales, which will amount to $2,919,000,000.

It would appear, therefore, that the total net cash sales of both crops and animal products for the current season will be approximately $5,847,000,000, which will represent the total cash income of all farms in the United States.

The total number of farms as reported by the Bureau of the Census for 1910 was 6,362,000, which was an increase of 11 per cent over 1900. Assuming the same rate of increase since 1910, the present number of farms will be approximately 6,600,000. The average cash income per farm would, on this basis, be nearly $900. This does not represent net income, for out of this amount the farmer must pay for fertilizers, hire of help, stock feed, maintenance of farm equipment (including farm tools and machinery), and taxes.

Statistics of farm values of crops and animal products, as published by the Bureau of the Census for 1910, and the expenses of farm operation, were analyzed in Circular No. 132 of the Bureau of Plant Industry,[1] pages 3 to 7, inclusive, as shown by Table 1.

TABLE 1.—*Labor income of farmers in the United States.*

Page.[2]	Item.	Total.	Amount per farm.
268	Number of farms	6,361,502	138.1 acres.[3]
269	Improved land . . . acres	478,451,750	75.2 acres.
276	Total farm investment	$40,991,449,090	$6,443.67.
277	Investment in farm buildings	$6,325,451,528	$994.33.
277	Investment in implements and machinery	$1,265,149,783	$198.88.

[1] Issued July 19, 1913. [2] Abstract of the Thirteenth Census. [3] Average total area per farm.

TABLE 1.—*Labor income of farmers in the United States*—Continued.

RECEIPTS.

Page.	Item.			Total.	Amount per farm.
348	Dairy products (excluding milk and cream used at home)			$596,413,463	$93.75
352	Wool			65,472,328	10.29
352	Mohair			901,597	.14
355	Eggs produced			306,688,960	48.21
355	Poultry raised			202,506,272	31.83
356	Honey and wax			5,992,083	.94
358	Domestic animals sold			1,562,936,694	245.69
358	Domestic animals slaughtered			270,238,793	42.48
370	Total value of all crops		$5,487,161,223		
379	Corn	$1,438,553,919			
383	Oats	414,697,422			
388	Barley	92,458,571			
397	Hay, etc	824,004,877			
	Total value of crops used for feeding	2,769,714,789			
373	Feed sold	509,253,522			
	Net value of crops fed		2,260,461,267		
	Net value of crops			3,226,699,956	507.22
	Total gross farm income			6,237,850,146	980.55

EXPENSES.

	Labor	$651,611,287	$102.43
373	Fertilizers	114,882,541	18.06
373	Feed	299,839,857	47.13
373	Maintenance of buildings (at 5 per cent) [1]	316,272,576	49.72
	Maintenance of implements and machinery (20 per cent)	253,029,956	39.78
	Taxes (0.6 per cent)	245,948,694	38.66
	Total	1,881,584,911	295.78
	Miscellaneous expenses (15 per cent of other expenses)	282,237,736	44.37
	Total expenses	2,163,822,647	340.15

SUMMARY.

	Total gross income	$6,237,850,146	$980.55
	Total expenses	2,163,822,647	340.15
	Net farm income	4,074,027,499	640.40
	Interest on investment (at 5 per cent)	2,049,572,454	322.18
	Labor income [2]	2,024,455,045	318.22
	Interest on mortgage ($1,715 at 6 per cent)		102.90
	Available for purchase of live stock and for family living		537.50

[1] 4½ per cent in New England, New York, Pennsylvania, Michigan, and Wisconsin; 5 per cent in Virginia, West Virginia, Illinois, Missouri, Kansas, Iowa, Nebraska, Minnesota, North Dakota, South Dakota, Ohio, and Indiana; 5½ per cent elsewhere.

[2] Includes unpaid family labor and all the farm furnishes toward the family living except milk and cream. Does not include income from outside sources, and the amount paid for live stock bought must be deducted from this sum.

The foregoing table indicates roughly the distribution of net cash income from sales of farm products, and shows very clearly that this income is not profit. The estimated total cash sales of farm products and the estimated cash income per farm and per capita in 1913 varies widely in different sections of the country, as shown by Table 2.

TABLE 2.—*Estimated value of sales of crops and live-stock products, total, per farm and per capita rural population, by divisions.*

Division.	Estimated value, in millions of dollars of farm sales from 1913 crop.			Estimated value of total sales per farm.	Estimated total sales per capita rural population (excluding towns).
	Crops.	Live-stock products.	Total.		
New England	$186	$374	$560	$836	$100
South Atlantic	570	186	756	657	97
North Central, east	410	701	1,111	950	152
North Central, west	956	934	1,890	1,629	273
South Central	615	449	1,064	516	92
Western	191	275	466	1,195	155
United States	2,928	2,919	5,847	892	139

It will be noted that the smallest average cash income per farm and per capita is obtained in the South central division, which includes Kentucky, Tennessee, Alabama, Mississippi, Louisiana, Texas, Oklahoma, and Arkansas, where the labor of a relatively large number of adults and children is required to produce the crop. The largest average cash income per farm and per capita is shown in the North central, west division, including the States of Minnesota, Iowa, Missouri, North Dakota, South Dakota, Kansas, and Nebraska.

It is evident from the foregoing analysis of farm expenses and the variation of cash income per farm in different sections that the enormous aggregates of farm production and values as estimated for the whole United States in 1913 do not mean that the average farmer is realizing any material profit over and above what might reasonably be expected from his labor and investment. On the contrary, if cash income per farm and per capita alone is considered it would appear that in many sections farmers and their families do not make wages comparable with wages received in other occupations requiring an equal degree of experience, intelligence, and skill. Furthermore, the average farm income as estimated herein is by no means certain, all farm products depending upon many uncertain factors, such as unfavorable weather conditions, the depredations of insects, and the ravages of numerous plant and animal diseases, while the only certainty regarding farm prices is that they will be far below the retail prices paid by consumers. The uncertainty of the farmer's cash income, however, is more than offset by the certainty of a livelihood and the sense of permanent security afforded by ownership or a long-term lease of the farm and equipment, and the fact that he is his own employer and does not have to make cash payments at frequent intervals for his house rent, water, fuel, and a large part of the food of his family, which are supplied by the farm.

However desirable increased production on farms may appear to be from the consumer's standpoint, it does not follow that such increased production would result in any increase in the cash income per farm or per capita of farm population, or that prices paid by consumers would be any lower. The estimated total farm production in 1913 is less than in 1912, yet the estimated gross and net cash returns to farmers are greater than in 1912. Had the total production in 1913 equaled or exceeded the 1912 production, it seems probable that the cash income per farm would not have been greater and might have been less than in 1912; but it is extremely doubtful whether the cost to the consumer would have been any less, because retail prices are promptly raised on a prospect of underproduction, but are very slow to decline if there is overproduction. The long line of distributors and middlemen between the farmer and the consumer are in a position to take advantage of the market, and to a certain extent control the market, in both directions, because they are better organized to keep informed of crop and market conditions, and to act promptly, than either farmers or consumers, who are not organized, and as individuals are helpless. The high prices paid by consumers, ranging from 5 to nearly 500 per cent, in some cases, more than the farmer receives, indicate that there is plenty of room for lowering the cost of farm products to consumers and at the same time largely increasing the cash income per farm without increasing farm production. This condition is undoubtedly a marketing problem, which will have to be solved by better organization of farmers and improved methods of marketing. When as the result of such organization and improved methods the price of farm products can be maintained at a higher level without increasing the cost to consumers, farmers will be justified in increasing the output of their farms with a fair prospect of realizing a reasonable profit on their investment of time, labor, and money, which in the aggregate is enormous.

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ESTIMATED FARM PRODUCTION OF 1913.

TOTAL VALUE BREAKS THE RECORD.

In monetary value of products the farms of the United States have broken the annual record, although the volume of production, as indicated in the Secretary's report, was materially below the average. The total value for 1913 is $9,750,000,000, nearly one-half a billion dollars above the value for 1912, which was itself a record year. This amount is composed of estimates for the items that make the census total of farm products. It is far from being equivalent to the total sales of farm products, but its items are the values of farm crops, of farm animals sold and slaughtered, and of farm-animal products. A sum of such elements is to be accepted as an index number, useful for comparison with numbers similarly made for other years. If the value of the products of the farm for the census year 1909 is regarded as represented by 100, the corresponding value for 1913 is represented by 115; or, if 100 represents the value of farm products for the census year 1899, the index number for 1913 is 207, indicating more than twice the value of the former year, 14 years earlier.

The crops of 1913 have an estimated value at the farm of $6,100,000,000, and this amount has never before been equaled. In 1909 the value of crops was about 5¾ billions, and in 1899 it was 3 billions of dollars, or less than half of the crop value of 1913.

The estimated value of farm animals sold and slaughtered and of farm-animal products for 1913 is $3,650,000,000, or $100,000,000 above the amount of the record year 1910. It compares with 3 billion dollars for 1909 and with more than 1¾ billion dollars in 1899. Within the last few years the value of farm animals sold and slaughtered and of farm-animal products for one year has tended to increase in a somewhat greater degree than that of farm crops.

PRODUCTION AND VALUE OF CROPS.

CORN.

A summary of the acreage, production, and value of the crops of 1913, 1912, and 1911 may be found in Table 3. The value of the corn crop of 1913 is far above that of any other crop. It is estimated at $1,692,000,000, and has not been equaled by the corn crop of any previous year. This amount is 28 per cent of the estimated value of all crops, and is over 12 per cent above the average value of the five preceding corn crops. The estimated corn production of 1913 was only 2,447,000,000 bushels, on account of a prolonged drought throughout the corn belt. This quantity has been exceeded a dozen times and is 11 per cent under the average of the preceding five years. The loss of production was more than counterbalanced by the increase in price. On December 1 the farm price for corn per bushel was 69.1 cents, a figure that has not been equaled, by 5.5 cents, since the department's record began in 1866. Iowa, Illinois, and Indiana are the leading corn States in 1913 in the order mentioned. The estimated area of this crop in 1913 was 105,820,000 acres, a decline of over 1 per cent below 1912.

COTTON.

The cotton crop now seems to be established in value as next in order after corn. The lint of this crop in 1913, at the price of December 1, had an estimated value of $798,000,000, and this was not equaled in any former year. It is 14½ per cent above the average of the preceding five years. The estimated number of bales of 500 pounds gross weight in this crop is 13,677,000; consequently this crop has been exceeded in quantity by the crops of 1911 and 1912. If the estimated value of the cotton seed is added to that of lint, the total farm value of this crop amounts to $945,000,000, an increase of 16 per cent over the average of the previous five years. Texas usually produces from one-fourth to one-third the cotton crop of the United States. The cotton crop of the United States in 1913 covered 36,011,000 acres, it is estimated, an increase of 5 per cent over 1912.

HAY.

Third in order of value is the hay crop, worth at the farm at the price of December 1, $797,000,000, according to the estimate, an amount nearly 9 per cent above the average of the preceding five years, and exceeded in value by the crop only of 1912. In estimated quantity this crop amounted to a little over 64,000,000 tons in 1913, an amount slightly under the average of the previous five years, and exceeded by the crops of four years. In the order named, New York, Iowa, and Pennsylvania are the leading hay States in 1913. The crop of this year was cut from 48,954,000 acres, according to the estimate.

WHEAT.

The largest crop of wheat ever raised in this country was that of 1913, being over 763,000,000 bushels, valued at $610,000,000. Of course these are estimates. Two former wheat crops have been more valuable. Compared with the average of the five preceding years this crop is 4 per cent greater, and 14½ per cent more valuable. The high production of this year is due to the extraordinary size of the winter wheat crop, which considerably exceeded the highest previous production, and amounted to nearly 524,000,000 bushels. In the production of wheat in 1913 the leading States are Kansas, North Dakota, and Minnesota in the order named. The estimated wheat area, this year, was 50,184,000 acres, an increase of nearly 10 per cent over 1912.

OATS.

The estimated crop of oats in 1913 was exceeded in quantity by that of two preceding years and amounted to 1,122,000,000 bushels, harvested from 38,399,000 acres. This was 5 per cent greater than the average of the preceding five years. The value of the crop was 6 per cent greater than the average of those years, and amounted to $440,000,000, which was exceeded only by the value of the crop of 1912. The principal States in production of oats in 1913 in the order named are Iowa, Minnesota, and Illinois.

TABLE 3.—*Crop areas, yields, and values, 1913.*

Crops.	Acreage.	Production.[1]		Farm value, Dec. 1.	
		Per acre.	Total.	Per bushel.	Total.
Corn:	*Acres.*	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
1913	105,820,000	23.1	2,446,988,000	69.1	1,692,092,000
1912	107,083,000	29.2	3,124,746,000	48.7	1,520,454,000
1911	105,825,000	23.9	2,531,488,000	61.8	1,566,258,000
Winter wheat:					
1913	31,699,000	16.6	523,561,000	82.9	433,995,000
1912	26,571,000	15.1	399,919,000	80.9	323,572,000
1911	29,162,000	14.8	430,656,000	88.0	379,151,000
Spring wheat:					
1913	18,485,000	13.0	239,819,000	73.4	176,127,000
1912	19,243,000	17.2	330,348,000	70.1	231,708,000
1911	20,381,000	9.4	190,682,000	86.0	163,912,000
All wheat:					
1913	50,184,000	15.2	763,380,000	79.9	610,122,000
1912	45,814,000	15.9	730,267,000	76.0	555,280,000
1911	49,543,000	12.5	621,338,000	87.4	543,063,000
Oats:					
1913	38,399,000	29.2	1,121,768,000	39.2	439,596,000
1912	37,917,000	37.4	1,418,337,000	31.9	452,469,000
1911	37,763,000	24.4	922,298,000	45.0	414,663,000
Barley:					
1913	7,499,000	23.8	178,189,000	53.7	95,731,000
1912	7,530,000	29.7	223,824,000	50.5	112,957,000
1911	7,627,000	21.0	160,240,000	86.9	139,182,000
Rye:					
1913	2,557,000	16.2	41,381,000	63.4	26,220,000
1912	2,117,000	16.8	35,664,000	66.3	23,636,000
1911	2,127,000	15.6	33,119,000	83.2	27,557,000
Buckwheat:					
1913	805,000	17.2	13,833,000	75.5	10,445,000
1912	841,000	22.9	19,249,000	66.1	12,720,000
1911	833,000	21.1	17,549,000	72.6	12,735,000
Flaxseed:					
1913	2,291,000	7.8	17,853,000	$1.20	21,399,000
1912	2,851,000	9.8	28,073,000	$1.15	32,202,000
1911	2,757,000	7.0	19,370,000	$1.82	35,272,000
Rice:					
1913	827,100	31.1	25,744,000	85.8	22,090,000
1912	722,800	34.7	25,054,000	93.5	23,423,000
1911	696,300	32.9	22,934,000	79.7	18,274,000
Potatoes:					
1913	3,668,000	90.4	331,525,000	68.7	227,903,000
1912	3,711,000	113.4	420,647,000	50.5	212,550,000
1911	3,619,000	80.9	292,737,000	79.9	233,778,000
Sweet potatoes:					
1913	625,000	94.5	59,057,000	72.6	42,884,000
1912	583,000	95.2	55,479,000	72.6	40,264,000
1911	605,000	90.1	54,538,000	75.5	41,202,000
Hay:					
1913	48,954,000	[2] 1.31	[2] 64,116,000	[3] $12.43	797,077,000
1912	49,530,000	[2] 1.47	[2] 72,691,000	[3] $11.79	856,695,000
1911	48,240,000	[2] 1.14	[2] 54,916,000	[3] $14.29	784,926,000
Tobacco:					
1913	1,216,000	[4] 784.3	[4] 953,734,000	[5] 12.8	122,481,000
1912	1,226,000	[4] 785.5	[4] 962,855,000	[5] 10.8	104,063,000
1911	1,013,000	[4] 893.7	[4] 905,109,000	[5] 9.4	85,210,000
Cotton:					
1913	36,011,000	[4] 181.9	[6] 13,677,000	[5] 12.2	797,841,000
1912	34,283,000	[4] 190.9	[6] 13,703,000	[5] 11.9	781,806,000
1911	36,045,000	[4] 207.7	[6] 15,693,000	[5] 8.8	660,566,000
Sugar beets:					
1913	577,000	[2] 10.11	[2] 5,834,000	[3] $5.90	34,420,000
1912	555,000	[2] 9.41	[2] 5,224,000	[3] $5.82	30,406,000
1911	474,000	[2] 10.68	[2] 5,062,000	[3] $5.50	27,843,000
Total, above crops:					
1913	299,433,000				4,940,301,000
1912	294,764,000				4,758,925,000
1911	297,167,000				4,589,529,000

[1] Bushels of weight.
[2] Tons (2,000 lbs.).
[3] Per ton.
[4] Pounds.
[5] Per pound.
[6] Bales of 500 pounds, gross weight, excluding linters.

POTATOES.

Potatoes stand fifth among the crops in order of estimated value, the amount for 1913 being $228,000,000, an amount that was exceeded in only one year, and was 13½ per cent above the average of the preceding five years. From 3,668,000 acres, estimated, the estimated production was 332,000,000 bushels, which was below the five-year average and was exceeded by the crops of four other years. On account of the low production, the price December 1, 68.7 cents, was exceptionally high and has been exceeded in but few years as far back as 1866. The leading States in the production of potatoes this year in the order named are Michigan, Wisconsin, and Minnesota.

TOBACCO.

Tobacco follows next below the potato crop in order of value in 1913. The average farm price of this crop, 12.8 cents per pound, is the highest since 1864. The tobacco crop of 1913 is the most valuable one ever raised in this country and exceeds in value by over 30 per cent, the average of the preceding five years. The quantity of the production, however, is slightly under that average and has been exceeded by three former crops.

The final estimate of the production of tobacco in 1913 is 953,734,000 pounds, compared with 962,855,000 pounds in 1912, a reduction of 9,121,000 pounds, or less than 1 per cent. The average price per pound on December 1 was 12.8 cents, against 10.8 cents December 1 last year, an advance of 2 cents. The December 1 value is estimated to be $122,481,000, compared with $104,063,000 in 1912, an advance of $18,418,000, or 17.7 per cent.

Cigar tobacco.—The leading States in the production of this crop in 1913 are Kentucky, North Carolina, and Virginia in the order named.

The total production of cigar tobacco is estimated at 183,350,000 pounds, or 17.0 per cent less than last year, with a total value of $24,075,000, or less than in 1912.

In Georgia and Florida the yield per acre is better than last year, and quality is the best for several years. In all the other districts the yield per acre is less than last year and quality not up to the usual standard of a good crop, except in the Miami Valley of Ohio, where the cured product, while of smaller growth than usual, has otherwise fine quality. The New England crop shows a smaller percentage of wrapper than usual. Quality in Pennsylvania is inferior to that of 1912. In Wisconsin, while quality is better than it was last year, the crop is not fine. Yield per acre is less and price higher than in 1912.

Chewing, smoking, snuff, and export tobacco.—The estimated total production of chewing, smoking, snuff, and export tobacco is 763,124,000 pounds, compared with 733,070,000 pounds last year, an increase of 30,054,000 pounds, or 4.1 per cent. The total value is $97,466,000, while last year's was $75,926,000, showing an increase of $21,540,000, or 28.4 per cent. The largest increase is in the bright districts of Virginia, North Carolina, and South Carolina, where a larger crop has brought a higher price.

The Burley district has a smaller production with poorer quality than last year, but shows an advance in price.

The sun-cured district of Virginia had a fine crop when harvested, and curing was about finished in good condition when a week or 10 days of hot, damp weather in October did serious damage by causing leaf to mold while hanging in the barns. What promised to be a fine crop was much reduced in quality and value.

In the dark district of Virginia a part of the tobacco has good quality, but a large per cent was damaged by a hail and wind storm early in September. The yield per acre is higher than last year, while the price is low.

In the old belt of Virginia and North Carolina, quality is much better than last year, except for a part damaged by hail and wind during the latter part of harvest. Less color is shown than last year, but otherwise quality is fine. Yield per acre is better, while the price is the highest for many years.

In the new belt of North Carolina and South Carolina yield and quality are below last year. Price is higher, and in eastern North Carolina is the highest ever realized.

The Maryland and eastern Ohio export district shows better yield per acre and better price than last year, with quality about the same.

The perique of Louisiana shows better yield and quality, but lower price than in 1913.

BARLEY.

The barley crop of 178,000,000 bushels as estimated has been exceeded twice in quantity and is 1 per cent below the average production of the preceding five years. The estimated value of this crop, $96,000,000, has declined in greater degree than has the production. Four barley crops have exceeded this one in value and it is 11 per cent below the average value of the crops of the preceding five years. The principal barley States in 1913 are Minnesota, California, and North Dakota, in the order named.

SWEET POTATOES.

Sweet potatoes have recently been added to the list of crops for which quantitive estimates are made. This crop had a production of 59,000,000 bushels in 1913, with a farm value of $43,000,000, and the figures for both production and value are larger than those for 1912. In the order named, North Carolina, Georgia, and Alabama are the leading States in the production of sweet potatoes in 1913.

TABLE 4.—*Area, yield per acre, production, and the December 1 farm value of tobacco grown in the United States in 1913, 1912, 1911, and 1910, by types and districts.*

Type and district.	Acreage (00 omitted).				Yield per acre.				Production (000 omitted).				Price per pound Dec. 1.				Total farm value on basis of Dec. 1 price (000 omitted).			
	1913	1912	1911	1910	1913	1912	1911	1910	1913	1912	1911	1910	1913	1912	1911	1910	1913	1912	1911	1910
I. CIGAR TYPES.	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*
New England	247	235	228	217	1,550	1,700	1,632	1,729	38,295	39,950	37,205	37,527	21.0	24.0	20.3	16.1	8,033	9,589	7,565	6,043
New York	43	40	38	40	1,020	1,300	1,330	1,250	4,386	5,200	5,054	5,000	12.2	12.6	10.4	8.5	535	655	526	425
Pennsylvania	389	442	460	430	1,200	1,420	1,420	1,500	46,680	64,090	65,320	64,500	7.5	8.5	9.5	9.3	3,501	5,448	6,205	5,999
Ohio—Miami Valley	513	540	600	700	730	990	930	800	37,449	53,460	55,800	56,000	11.0	8.0	7.8	8.2	4,119	4,277	4,352	4,592
Wisconsin	430	422	410	340	1,180	1,290	1,250	1,050	50,740	54,438	51,250	35,700	12.0	11.0	10.0	7.5	6,089	5,988	5,125	2,677
Georgia and Florida	58	45	38	51	1,000	837	927	680	5,800	3,766	3,524	3,468	31.0	30.0	28.0	22.1	1,798	1,130	987	765
II. CHEWING, SMOKING, SNUFF, AND EXPORT TYPES.																				
Burley district	2326	2,280	1,900	3,300	760	860	920	830	176,776	196,080	174,800	273,900	12.3	11.0	7.5	9.6	21,743	21,569	13,110	26,294
Dark districts of Kentucky and Tennessee:																				
Paducah district	750	1,000	750	992	780	620	800	750	58,500	62,000	60,000	74,400	7.7	6.2	8.0	7.8	4,504	3,844	4,800	5,803
Henderson or stemming district	550	1,050	740	1,120	800	800	900	800	44,000	84,000	66,600	89,600	7.3	7.0	7.7	7.2	3,212	5,880	5,128	6,451
Upper Green River district	234	360	300	350	720	730	850	850	16,848	26,280	25,500	29,750	7.0	6.5	7.0	7.4	1,179	1,708	1,785	2,201
Upper Cumberland district	150	230	180	220	760	720	860	750	11,400	16,560	15,480	16,500	7.3	6.5	7.0	6.8	832	1,076	1,084	1,122
Clarksville and Hopkinsville district	1150	1,200	900	1,200	700	660	810	760	80,500	79,200	72,900	91,200	9.0	7.8	9.0	8.8	7,245	6,178	6,561	8,026
Virginia sun-cured district	159	150	120	150	800	650	800	810	12,720	9,750	9,600	12,150	8.5	8.0	9.0	8.5	1,081	780	864	1,033
Virginia dark district	712	750	600	800	820	660	850	800	58,384	49,500	51,000	64,000	7.0	7.8	8.4	8.0	4,087	3,861	4,284	5,120
Bright yellow district:																				
Old belt—Virginia and North Carolina	2400	2,040	1,710	2,050	690	540	740	700	165,600	110,160	126,540	143,500	18.5	15.2	10.8	10.4	30,636	16,744	13,666	14,924
New belt—Eastern North Carolina and South Carolina	1650	1,060	680	1,150	710	730	730	550	117,150	77,380	49,640	63,250	17.9	16.1	12.6	10.0	20,970	12,458	6,255	6,325
Maryland and eastern Ohio export	276	310	310	377	760	710	745	735	20,976	22,010	23,095	27,710	9.1	8.1	7.5	7.7	1,909	1,783	1,732	2,134
Perique Louisiana	6	5	5	5	450	300	450	550	270	150	225	275	25.0	30.0	31.0	25.0	68	45	70	69
Scattering	106	99	159	169	.....	.....	.....	.....	7,260	8,881	11,576	14,985	.....	.....	.....	.....	940	1,050	1,111	2,139

SUGAR.

The production of sugar beets for sugar making is found chiefly in half a dozen States, which have the following order in quantity of beets produced: Colorado, California, Michigan, Utah, Idaho, and Ohio. The estimated quantity of beets grown in 1913 was 5,834,000 short tons, a figure that has not been reached in any former year and which exceeded by 34½ per cent the average quantity of the five previous years. The estimated value of these beets at the factory was over $34,000,000, an amount which was higher than that of any former year and was 48 per cent higher than the average of the preceding five years.

Sugar cane had an estimated production of about 6,150,000 short tons, a quantity that has been exceeded half a dozen times, as has also the estimated value of this cane, $21,000,000. About 5,000,000 tons are grown for sugar making, almost exclusively in Louisiana, and the balance of the crop is used for seed and for making sirup.

The beet and cane sugar industries combined will have produced 1,081,000 short tons of sugar by the end of the campaign of 1913–14 with a factory value of $87,000,000, according to the estimates. If the by-products are added, the estimated value of the products of these two sugar industries will amount to $119,000,000. The product of sugar by these two industries in 1913–14 is larger than ever before, but the value has been exceeded in one previous year.

The industry of making sugar from beets will have produced by the end of the campaign of 1913–14 about 727,000 short tons of sugar, practically all refined. This is a preliminary estimate and is to be accepted only tentatively, but it indicates considerably the largest production of beet sugar in one year that this country has had and is 33 per cent above the average of the preceding five years. The estimated value of this sugar is 13 per cent above the average of those years and amounts to about $61,000,000, but this value has been exceeded in two former years. The beet pulp, molasses, and other by-products of this industry, added to the value of the sugar, make a probable total of $63,000,000. Returns from about three-fourths of the beet-sugar factories indicate a larger area and production of sugar beets in the United States in 1913 than last year. The estimates of acreage and production of beets for 1913, and of production of sugar for the campaign of 1913–14, in Table 5, are based upon conditions existing in the first part of the campaign and are subject to correction when later and more complete returns are available.

TABLE 5.—*Area and production of sugar beets, and production of beet sugar in the United States, 1912–13.*

State.	Beets used.				Sugar made.	
	Area.		Production.			
	1912	1913 (preliminary).	1912	1913 (preliminary).	1912–13	1913–14 (preliminary).
	Acres.	*Acres.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
California	111,416	120,000	1,004,328	1,094,000	158,904	160,000
Colorado	144,999	157,000	1,641,861	1,800,000	216,010	215,000
Idaho	19,952	22,000	170,619	244,000	24,761	32,000
Michigan	124,241	113,000	838,784	937,000	95,049	119,000
Ohio	27,062	27,000	263,005	234,000	28,503	27,000
Utah	37,000	40,000	445,130	507,000	59,571	57,000
Other States	90,630	98,000	860,650	1,018,000	109,758	117,000
United States	555,300	577,000	5,224,377	5,834,000	692,556	727,000

LOUISIANA CANE-SUGAR INDUSTRY.

The cane-sugar industry by the end of the campaign of 1913–14 will have produced, as a preliminary estimate, 354,000 short tons of sugar, a production that has been exceeded half a dozen times. Its value is estimated at $26,000,000, and if the by-products of the industry are added, the total becomes about $40,000,000, which has been exceeded half a dozen times.

From conditions existing up to November 20, it is estimated that about 5,000,000 tons of cane (Table 6) will be used for sugar in Louisiana in the current campaign (1913–14). This total is based upon reports for 158 operating factories and upon estimates for 5. At least 26 sugar factories are not in operation this season.

No estimate of sugar production is made at this time, but in the early part of the campaign the average yield of sugar per ton of cane was not far from normal.

Results of the last two campaigns, with preliminary data for 1913, are shown in Table 6.

TABLE 6.—*Cane and sugar in Louisiana.*

Year of cane harvest.	Number of sugar factories in operation.	Cane used for sugar.	Sugar made.	
			Total.	Average per ton of cane.
		Short tons.	*Pounds.*	*Pounds.*
1911	188	5,887,292	705,748,000	120
1912	126	2,162,574	317,146,000	142
1913 (preliminary estimate)	163	5,067,000	....	....

HAWAIIAN SUGAR AND CANE PRODUCTION.

Although Hawaii is outside of the territory covered by the agricultural estimates usually made by the Bureau of Statistics (Agricultural Forecasts), information recently received from the Hawaiian sugar factories is here inserted as pertinent to the general subject of cane and sugar production (Table 7).

The Hawaiian cane-sugar production for the year ending September 30, 1913, amounted to 551,000 short tons, the lowest since 1909–10, when 517,090 short tons were produced. The crop of 1910–11 was 566,821 tons, and the succeeding crops are shown below.

In 1912–13, the average yield of sugar per ton of cane was 244 pounds, and the cane itself averaged 39 tons per acre. Of the four islands represented in these returns, Hawaii produced 197,000 tons of sugar; Kauai, 105,000; Maui, 125,000; and Oahu, 124,000 tons.

TABLE 7.—*Preliminary returns of the Hawaiian cane-sugar campaign ending Sept. 30, 1913, and comparison with two preceding years.*

Year ending Sept. 30—	Factories in operation.	Sugar made.		Cane used.		Area of cane used.
		Total.	Average per ton of cane.	Total.	Average yield per acre.	
		Short tons.	*Pounds.*	*Short tons.*	*Short tons.*	*Acres.*
1911	50	574,478	238	4,835,000	41	117,000
1912	51	596,038	249	4,774,000	42	113,000
1913 (preliminary)	50	551,000	244	4,517,000	39	115,000

RYE.

Rye is a crop that has occupied a rather stationary place in the estimates of the bureau for many years, but a marked extension of area and appreciable increase of production developed in case of the crop harvested in 1913. This is a fall-sown crop and its increase in acreage in 1913 was due largely to its greater utilization for pasturage in autumn and spring in the States extending from Ohio westward to the plains States. The estimated production in 1913 was over 41,000,000 bushels, making this crop easily the largest one ever produced in this country, and over 25 per cent greater than the five-year average. The estimated value of this crop, $26,000,000, was exceeded by the crop of only one former year and is greater by 9 per cent than the five-year average. Chief among the rye States in the order mentioned are Wisconsin, Minnesota, and Michigan.

RICE.

The estimated rice crop of nearly 26,000,000 bushels, or more than 1,158,000,000 pounds of rough rice, in 1913 is the largest one ever raised in this country and exceeds by 11 per cent the average of the previous five years. In estimated value this crop ranks second, the amount being over $22,000,000, or 20 per cent above the five-year average. This crop has almost become extinct in the Atlantic States, where it once had commercial importance, and the commercial crop is now produced almost entirely in Louisiana, Texas, and Arkansas.

FLAXSEED.

The production of flaxseed declined considerably in 1913, and was over 15 per cent below the five-year average. This crop's value is estimated at more than $21,000,000, or 32 per cent below the five-year average. The crop of this year has been exceeded many times in both quantity and value. Chief among the States that produce flaxseed are North Dakota, Montana, and Minnesota, in the order named.

HOPS.

The estimate of the hop crop is over 56,000,000 pounds, valued at less than $15,000,000. The production has been exceeded in two years and is 18 per cent above the average of the previous five years, while the estimated value of the crop has been exceeded only once and is over 42 per cent above the five-year average.

BUCKWHEAT.

Buckwheat, with an estimated production of nearly 14,000,000 bushels, has been exceeded in production many times and is nearly 19 per cent below the five-year average. Its value is estimated at over $10,000,000, and in this respect also the crop has been exceeded many times, and it is nearly 11 per cent under the five-year average. Chief among the buckwheat-raising States are Pennsylvania, New York, and Michigan, in the order mentioned.

TOTAL CEREAL PRODUCTION AND VALUE.

The cereals are all expressed in bushels and, although these bushels differ in weight and the cereals differ in their characteristics, the sum of the cereals for a series of years indicates in a comprehensive way the drift of production. In 1913, 4,591,000,000 bushels of cereals were produced, it is estimated, a quantity that has been exceeded in three years and that is 3 per cent under the average of the previous five years. On the other hand, the estimated value of the cereals of 1913 is $2,896,000,000, which is nearly 5 per cent above the highest figure yet reached by them and is almost 9 per cent above the average of the preceding five years. Nearly the entire amount of the increase in value of the cereals above their value in 1912 is due to the increase in value of the corn and wheat crops of this year over those of last year.

PRODUCTION AND VALUE COMPARISONS.

In quantity of estimated production, the record has been broken by wheat, rye, rice, sugar beets, beet sugar, and the total of beet and cane sugar. Of the remaining crops, oats, barley, cotton, and hops have been exceeded twice in production. The estimated production of the other crops of which separate account is made was relatively low.

The value of the crops of 1913 is high. A new high record in estimated value is made by the total of all cereals, and separately by corn, cotton, cotton seed, tobacco, and sugar beets. Only once has there been a higher estimated value for oats, rye, rice, potatoes, hay, hops, and the total of beet and cane sugar. Only twice has the estimated value of wheat and of beet sugar been exceeded.

If comparison be made with the average of the preceding five years, estimated production is lower for barley, buckwheat, corn, flaxseed, hay, potatoes, and tobacco, and estimated production is higher for oats, rice, rye, wheat, cotton, cotton seed, sugar beets, and hops. A better showing is made for the estimated values of these crops. Compared with the five-year average, lower values are estimated for barley, buckwheat, and flaxseed, whereas higher ones are estimated for corn, oats, rice, rye, wheat, cotton, cotton seed, sugar beets, hay, potatoes, tobacco, and hops. The estimated value of all crops for 1913 is nearly 11 per cent above the five-year average.

The crops for which acreage and quantitative estimates of production are made annually by the Bureau of Statistics represented in 1913 nearly 85 per cent of the value of all crops in 1909 and over 88 per cent of all crops in 1899; or nearly 92 per cent of the value of crops having census reports of acreage in 1909, and nearly 96 per cent of the value of such crops in 1899. From the aspect of acreage these crops represent about 97 per cent of all crops having census acreage reports in 1909, and 98 per cent in 1899.

Details by States for acreage, production, and value of all crops for which quantitative estimates are made for 1913 may be found in Tables 11 to 25.

ANIMAL PRODUCTS.

It is estimated that the farm animals sold and slaughtered during the year had a farm value of $2,206,000,000, or more than 20 per cent above the five-year average, although the number of these animals sold and slaughtered remained about the same as the five-year average.

The dairy products of 1913 are estimated at more than $814,000,000, or nearly 6 per cent more than the average for the preceding five years. The eggs produced and fowls raised have an estimated value of more than $578,000,000, or more than 4 per cent above the five-year average.

The wool production of 1913, estimated at 304,000,000 pounds, was over 3 per cent under the average of the five preceding years, and its estimated value at a low average price was over $51,000,000, or over 11 per cent below the five-year average.

PRICE TENDENCIES.

The common phenomenon of record yield and crop value below the record, and of record crop value with low production is presented by more than half a dozen of the crops of 1913. If the farmer gets a high price, perhaps a very high price, per bushel or other unit of quantity in case of a crop of low production, on the other hand he usually gets but low prices for the crops which he produces in abundance.

The prices of 14 principal crops average about 20.2 per cent higher than a year ago and 4.6 per cent higher than two years ago. Their total values average about 3.8 per cent higher than a year ago and 7.6 per cent higher than two years ago. Hence aggregate production averaged about 13.6 per cent less than a year ago and 2.9 per cent more than two years ago.

FARM PRICES OF STAPLE CROPS.

The general level of farm prices of staple crops decreased approximately 0.9 per cent from November 1 to December 1. Last year from November 1 to December 1 there was a decline in price level of 6.8 per cent, and for the last five years there has been an average decline in price level from November 1 to December 1 of 2.9 per cent. The average level of prices on December 1 was about 20.3 per cent higher than on December 1 last year, 0.3 per cent lower than two years ago (the year in which crop production was smaller than this year), and 9.3 per cent higher than the average of the last five years on December 1.

FARM PRICES OF MEAT ANIMALS.

The average price to producers of meat animals (beef cattle, veal calves, hogs, sheep, lambs, and chickens) on November 15 was about $6.94 per 100 pounds, which compared with $7.12 on October 15, $6.45 on November 15 a year ago, $5.45 two years ago, and $6.47 three years ago.

The decline of 2.5 per cent in price level from October 15 to November 15 compared with a decline of 5.9 per cent in the same period last year, 2.4 per cent two years ago, and 4.8 per cent three years ago.

FARM PRICES OF MISCELLANEOUS PRODUCTS.

Prices at the farm have been reported monthly for the following commodities beginning with 1908: Corn, wheat, oats, barley, rye, buckwheat, flaxseed, potatoes, hay, cotton, butter, eggs, and chickens.

From December 1, 1912, to December 1, 1913, the price of chickens per pound increased from 10.8 to 11.4 cents; the price of eggs increased from 29.7 to 33 cents; the price of butter increased from 28.8 to 29.2 cents; the price of cotton increased from 11.9 to 12.2 cents; of hay, from $11.79 to $12.43; of potatoes, from 50.5 to 68.7 cents; of flaxseed, from 114.7 to 119.9 cents; of buckwheat, from 66.1 to 75.5 cents; of barley, from 50.4 to 53.7 cents; of oats, from 31.9 to 39.2 cents; of wheat, from 76 to 79.9 cents; and of corn, from 48.7 to 69.1 cents. In the meantime the price of rye declined from 66.3 to 63.4 cents. The above prices are those paid to producers.

TENDENCY OF YIELD PER ACRE.

The yields per acre of 10 principal crops have been converted to index numbers, in computing which 100 represents the average yield per acre of the 10 years 1903–1912; and the index numbers for these 10 crops have been consolidated into one series of index numbers. The results may be found in Table 8. A glance along the line for 1913 at once discovers that this year was one of low estimated production per acre. The only crops of the 10 that are represented by a number greater than the average are wheat and rye. The 3 years 1904–5–6 were ones of high estimated production per acre for the combined 10 crops and these were followed by years of low estimated production per acre until 1912, when the highest production of the combined 10 crops for the 11 years embraced in the table is exhibited. The index number for 1913 for the combined crops is only 93 and the only year of the 11 with a lower estimated production per acre is 1911, represented by 90.

TABLE 8.—*Index figures of yield per acre of 10 products, 100 representing the average yield per acre of the 10 years, 1903–1912.*

Year.	Corn.	Wheat.	Oats.	Barley.	Potatoes.	Hay.	Cotton.	Tobacco.	Flax.	Rye.	10 crops combined.
1912	108	113	126	117	118	103	102	95	109	104	109
1911	89	88	82	83	84	77	112	109	78	97	90
1910	103	98	106	89	98	93	91	98	58	99	98
1909	95	110	100	91	111	100	83	98	104	100	97
1908	97	99	84	99	89	107	104	100	107	102	99
1907	96	99	80	94	99	102	96	103	100	102	96
1906	112	110	105	111	107	95	109	104	113	104	107
1905	107	103	114	105	91	108	100	99	123	102	105
1904	99	89	108	107	115	107	110	99	115	94	103
1903	94	91	95	104	88	108	93	95	93	96	96
1903-1912	100	100	100	100	100	100	100	100	100	100	100
1913	86	107	98	93	94	92	98	95	87	101	93

THE NATIONAL SURPLUS.

In these days of high prices of food, it seems to be overlooked that the farmers of this country are producing enormous surpluses for export to foreign countries. Prices are high in other countries as well as in this one.

The value of the agricultural exports of domestic production in the fiscal year 1913 was $1,123,021,469, an amount which has not before been equaled. The reexports, otherwise called the exports of foreign agricultural products, are estimated at $12,000,000. The so-called balance of trade in agricultural products is in favor of the exports of domestic farm products by $296,000,000.

During the fiscal year of 1913 over 166,000,000 pounds of beef and its products were exported, but this quantity included only somewhat more than 7,000,000 pounds of fresh beef. The quantity of exports of beef and its products has rapidly declined from 733,000,000 pounds in 1906. The exports of pork and its products in 1913 amounted to 964,000,000 pounds, a quantity that is exceeded by the average for the preceding 23 years and, with 3 exceptions, by the exports of each one of these years.

In no previous year have the exports of cotton been as large as they were in 1913, when the quantity was 9,545,000 bales of 500 pounds gross weight. The exports of this fiber have been increasing for many years. The cottonseed oil exports amounted to 42,000,000 gallons, an amount that compares favorably with that of preceding years. The wheat exports, including flour converted to wheat, more than equaled 141,000,000 bushels, and were not equaled since 1903, except in 1907 and 1908. Corn was exported to the amount of 51,000,000 bushels, a low figure in comparison with the average of the preceding 37 years. The exports of hops in 1913 amounted to nearly 18,000,000 pounds, and were exceeded in only two years. The exports of rice, rice bran, meal, and polish were 39,000,000 pounds—a high figure. The apple exports of 1913 were 2,150,000 barrels, a quantity greater than that of any previous year. There are many minor products which appear in the exports of the agricultural products of this country, some of which are gaining in quantity while others are undiminished or are declining.

AREA AND CONDITION OF GRAIN.

WHEAT.

The area of winter wheat sown in the fall of 1913, according to estimates based upon reports of correspondents and agents December 1, is 8.6 per cent more than the harvested estimated area sown in the fall of 1912 and is equivalent to an increase of 2,888,000 acres, the indicated total area being 36,506,000 acres. This is the largest area ever sown to winter wheat in this country, partly because of favorable weather for plowing and seeding, and partly because farmers in the belt of the severe drought of last summer desired to use the wheat for fall and spring pasturage. Among the leading States in winter wheat production are Kansas, Nebraska, and Illinois in the order named.

The condition of winter wheat December 1 was 97.2 per cent, an exceptionally high average and unequaled since 1903. It compared with a condition of 93.2 and 86.6 on December 1, 1912 and 1911, respectively, and a 10-year average of 89.2. During the last 25 years, only in 1891, 1897, and 1903 has the December condition of winter wheat been as high as in December of this year. It will be observed in Table 26 that the high condition prevails throughout the entire winter wheat belt and also in States of minor production.

During the last 10 years the average abandonment of area sown to winter wheat has been 9.8 per cent and, if the present area of this crop is reduced by this average abandonment, the area that will probably be harvested will be 32,928,000 acres. A condition of 97.2 indicates a yield of about 16.5 bushels per acre; so that on December 1 the indicated production of winter wheat is 543,000,000 bushels, or about 20,000,000 bushels above the record crop of 1913.

The closer we approach the time of harvest, the more nearly do the condition reports reflect, or forecast, the final outcome of the crop. On December 1, however, the crop is about seven months away from harvest and many dangers may intervene; so many in fact that the value of the December 1 report has been questioned as giving any indication of the final outturn of the crop. In the last 20 years the condition of the crop on December 1 has averaged 90.7 per cent and in the same period the condition on July 1 (practically at harvest) has averaged 78.8 per cent, an average decline during the seven months of 11.9 points. Of the 20 years, the 10 highest reports for December 1 averaged 95.5 per cent, and the 10 lowest, 86. The average condition on July 1 of the 10 crops which show the highest condition on December 1 was 80.6, and the average condition on July 1 of the 10 crops which show the lowest condition on December 1 was 77. Here is a striking parallel between the average condition on December 1 and the average condition on July 1, which is practically at harvest. Of the best 10 crops on December 1, seven remained among the best 10 at harvest.

RYE.

The area of rye sown during the fall of 1913, based upon reports of correspondents and agents, is 1.1 per cent less than the harvested estimated area sown in the fall of 1912, equivalent to a decrease of 29,000 acres, the indicated total area being 2,702,000 acres. This is the largest area ever sown to rye in this country.

The condition of the crop December 1 was 95.3, against 93.5 and 93.3 on December 1, 1912 and 1911, respectively, and a ten-year average of 92.7.

WAGES.

Farmers who employ wage labor find it difficult to meet the increasing rates. The average wage rates of farm labor without board in the United States increased from $22.12 to $29.58 per month from

1902 to 1912, or 33.7 per cent. In the North Atlantic States the increase was from $28.01 to $34.01, or 21.4 per cent; in the North Central States east of the Mississippi River, from $26.28 to $32.82, or 24.9 per cent; in the North Central States west of the Mississippi River, from $28.39 to $36.52, or 28.6 per cent; in the Western States, from $39.69 to $47.01, or 18.4 per cent; in the South Atlantic States, from $14.95 to $21.56, or 44.2 per cent; and in the South Central States, from $17.13 to $23.41, or 36.7 per cent. The heaviest percentages of increase are in the South.

At the average rates of wages for farm labor without board per month in the United States (using $29.58 of 1912) and the average prices of farm products at the farm in 1913, the quantity of each product specified below was required to pay a month's wages in 1913: Forty-three bushels of corn, or 37 bushels of wheat, or 75 bushels of oats, or 55 bushels of barley, or 47 bushels of rye, or 39 bushels of buckwheat, or 25 bushels of flaxseed, or 43 bushels of potatoes, or 2.4 tons of hay, or 242 pounds of cotton lint, or 101 pounds of butter, or 90 dozens of eggs, or 259 pounds of chickens.

The requirements for paying the average monthly wages without board (using $29.58 of 1912) may be expressed in terms of the acres necessary to produce crops sufficient to meet this expense. As an average for the United States, the corn needed for this purpose was harvested from 1.9 acres in 1913; the wheat, from 2.4 acres; the oats, from 2.6 acres; the barley, from 2.3 acres; the rye, from 2.9 acres; the buckwheat, from 2.3 acres; the flaxseed, from 3.2 acres; the potatoes, from one-half acre; the hay, from 1.8 acres; and the cotton, from 1.3 acres.

PRINCIPAL FARM EXPENSES.

The census reports indicate that in 1909 the total amount of farm wages paid to farm laborers was $651,611,287. This is almost double the cost in 1899, which was $357,391,930. Considerable increases in this item of expense are indicated since 1909.

The total amount paid out for fertilizer in 1909 was $114,882,541, and the increased use would indicate a still larger outlay this year. The amount expended for this purpose in 1899 was $53,430,910, less than half that in 1909.

SUBTROPICAL FRUITS IN CALIFORNIA AND FLORIDA.

Special reports concerning the subtropical fruits of southern California and Florida were made by correspondents and agents for December 1. These reports indicate, in the form of percentages, the estimated production of these fruits compared with a full crop. In California the olive crop of 1913 was 80 per cent of a full crop, the figures for 1912 and 1911 being respectively 64 and 87 per cent. Table grapes were produced in California to the extent of 83 per cent of a full crop in 1913, as compared with 89 per cent in 1912 and 85 per cent in 1911. The orange crop of California in 1913 was 80 per cent of a full crop—a low production, due to adverse weather; in Florida the orange crop of 1913 was 100, or in other words, it was equal to a full crop, in comparison with which the crop of 1912 is represented by 125 and the crop of 1911 by 66.

The lemon crop of California suffered with the oranges and amounted to only 57 per cent of a full crop in 1913, against which is 95 per cent of a full crop in 1912 and 92 per cent in 1911. The grapefruit crop of Florida in 1913 was 74 per cent of a full crop, compared with 105 per cent in 1912 and 57 per cent in 1911. In Florida 92 per cent of a full crop was the production of limes in 1913, compared with which is 75 per cent of a full crop in 1912 and also in 1911.

TABLE 9.—*Production compared with a full crop of subtropical fruits in California and Florida.*

Crop.	California.			Florida.		
	1913	1912	1911	1913	1912	1911
Olives	80	64	87			
Grapes, table	83	89	85			
Oranges	80	92	92	100	125	66
Lemons	57	95	92		100	58
Grapefruit				74	105	57
Limes				92	75	75

APPLE SHIPMENTS, 1913.

The first annual inquiry of the Bureau of Statistics (Agricultural Forecasts) to determine what percentage of the apple crop is shipped out of the counties where grown has been completed for 1913. The quantity shipped out of counties where grown corresponds roughly with what is known as the commercial crop. Of the production of 1913, 41 per cent was shipped out of the counties and 59 per cent was kept for local consumption.

In the New England States in 1913 the percentage of the crop shipped out of the producing counties was 47; for the Middle Atlantic States, 53; for the South Atlantic, 32; for the North Central east of the Mississippi River, 36; and the North Central west of the Mississippi, 20 per cent. The South Central States east of the Mississippi River, represented chiefly by Tennessee and Kentucky, reported only 8 per cent of the production as shipped out of the counties where grown, while the South Central States west of the Mississippi River, represented chiefly by Arkansas, reported the shipments as amounting to 34 per cent of the total. The highest percentages were for the Rocky Mountain and the Pacific States, which reported shipments, respectively, as 61 and 55 per cent of production.

The apple crop of 1913 was very small, especially on the Atlantic slope, and the surplus, that is, the "commercial crop," was reported to be relatively small compared with the total crop. Hence, except in years of small production, it may be expected that more than two-fifths of the entire apple crop is shipped out of the counties where grown. More definite data as to the relation between total production and the "commercial crop" are expected to result from subsequent yearly inquiries.

DURUM WHEAT MOVEMENT, 1912-13.

The durum wheat crop of 1912 was the largest since 1909. This is indicated by both receipts at primary markets and exports. According to returns made to the Bureau of Statistics (Agricultural Forecasts), the exports of durum wheat from the United States during the year beginning July 1, 1912, were 15,461,129 bushels, of which 507,050 were shipped through Portland, Me., 11,214,846 through New York, 2,140,703 through Philadelphia, 382,244 through Baltimore, and 1,216,286 bushels from Duluth through Canadian seaports.

Receipts at Duluth, during the same year, were 14,419,169 bushels, at Minneapolis 6,590,390, at Chicago 471,600, at St. Louis 851,050, and at Omaha 172,000, making a total of 22,504,209 bushels for the five markets.

A comparison of these exports and receipts with those of earlier years is shown in Table 10.

TABLE 10.—*Exports of durum wheat from the United States and receipts at five leading primary markets.*

Year beginning July 1—	Exports from United States.	Receipts at five leading primary markets.
	Bushels.	*Bushels.*
1907	27,063,478	31,600,604
1908	20,777,435	32,754,569
1909	18.344,972	34,627,025
1910	3,273,703	19,668,484
1911	1,851.988	5,829,622
1912	15,461,129	22,504,209

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TABLE 11.—**Corn:** *Estimates of acreage, production, and value, 1913 and 1912.*

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per bushel Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Dolls.*	*Dolls.*
Maine	16	16	38	40	608	640	87	75	529	480
New Hampshire	22	23	37	46	814	1,058	81	75	659	794
Vermont	45	45	37	40	1,665	1,800	81	72	1,349	1,296
Massachusetts	48	47	40	45	1,944	2,115	85	77	1,652	1,629
Rhode Island	11	11	36	42	402	456	99	88	398	401
Connecticut	61	60	38	50	2,348	3,000	85	77	1,996	2,310
New York	527	512	28	39	15,020	19,763	81	70	12,166	13,834
New Jersey	275	273	40	38	10,862	10,374	75	68	8,146	7.054
Pennsylvania	1,463	1,449	39	42	57,057	61,582	72	63	41,081	38.797
Delaware	197	195	32	34	6,206	6,630	59	51	3,662	3,381
Maryland	670	670	33	36	22,110	24,455	65	55	14,372	13.450
Virginia	1,980	1,980	26	24	51,480	47,520	76	71	39,125	33.739
West Virginia	732	725	31	34	22,692	24,505	80	65	18,154	15.928
North Carolina	2,835	2.808	20	18	55,282	51.106	88	83	48,648	42.418
South Carolina	1,975	1,915	20	18	38,512	34,278	97	85	37,357	29,136
Georgia	4,066	3,910	16	14	63,023	53.958	91	85	57,351	45,864
Florida	675	655	15	13	10,125	8,515	82	79	8,302	6,727
Ohio	3,900	4,075	38	43	146,250	174,410	63	45	92,138	78,484
Indiana	4,900	4,947	36	40	176,400	199,364	60	42	105,840	83,733
Illinois	10,450	10,658	27	40	282,150	426,320	63	41	177,754	174,791
Michigan	1,675	1,625	34	34	56,112	55,250	67	57	37,595	31,492
Wisconsin	1,650	1,632	40	36	66,825	58,262	60	51	40,095	29,714
Minnesota	2,400	2,266	40	34	96,000	78,177	53	37	50,880	28,925
Iowa	9,950	10.047	34	43	338,300	432,021	60	35	202,980	151,207
Missouri	7,375	7,622	18	32	129,062	243,904	74	46	95,506	112,196
North Dakota	375	328	29	27	10,800	8,758	52	43	5,616	3,766
South Dakota	2,640	2.495	26	31	67.320	76,347	56	37	37,699	28,248
Nebraska	7,610	7,609	15	24	114,150	182,616	65	37	74,198	67,568
Kansas	7,320	7,575	3	23	23,424	174,225	78	40	18,271	69,690
Kentucky	3,650	3,600	20	30	74,825	109,440	76	55	56,867	60,192
Tennessee	3,350	3,332	20	26	68,675	88,298	77	61	52,880	53,862
Alabama	3,200	3,150	17	17	55,360	54,180	89	79	49,270	42,802
Mississippi	3,150	3,106	20	18	63,000	56,840	77	71	48,510	40,356
Louisiana	1,900	1,805	22	18	41,800	32.490	77	68	32,186	22,093
Texas	6,800	7,300	24	21	163,200	153,300	82	64	133,824	98,112
Oklahoma	4,750	5,448	11	19	52,250	101,878	72	41	37,620	41,770
Arkansas	2,475	2,475	19	20	47,025	50,490	78	67	36,680	33,828
Montana	28	24	32	26	882	612	77	70	679	428
Wyoming	17	16	29	23	493	368	80	64	394	236
Colorado	420	420	15	21	6,300	8,736	73	50	4,599	4,368
New Mexico	85	93	18	22	1,572	2,083	75	75	1,179	1,562
Arizona	17	16	28	33	476	528	110	100	524	528
Utah	10	9	34	30	340	270	70	75	238	202
Nevada	1	1	34	30	34	30	118	98	40	29
Idaho	14	12	32	33	448	394	68	70	305	276
Washington	34	31	28	27	952	846	80	77	762	651
Oregon	21	20	28	32	598	630	70	75	419	472
California	55	52	33	37	1,815	1,924	88	85	1,597	1,635
United States	105,820	107,083	23.1	29.2	2,446,988	3,124,746	69.1	48.7	1.692,092	1,520,454

TABLE 12.—**Hay:** *Estimates of acreage, production, and value, 1913 and 1912.*

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per ton Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*
Maine	1,194	1,231	1.00	1.16	1,194	1,428	13.90	13.70	16,597	19,564
New Hampshire	495	501	1.00	1.25	495	626	17.20	15.00	8,514	9,390
Vermont	1,000	1,010	1.28	1.50	1,280	1,515	14.50	14.00	18,560	21,210
Massachusetts	475	477	1.21	1.25	575	596	21.10	21.50	12,132	12,814
Rhode Island	58	58	1.17	1.13	68	66	21.20	22.20	1,442	1,465
Connecticut	379	379	1.14	1.15	432	436	20.10	22.50	8,683	9,810
New York	4,700	4,720	1.14	1.25	5,358	5,900	15.30	14.90	81,977	87,910
New Jersey	361	362	1.30	1.44	469	521	19.00	20.00	8,911	10,420
Pennsylvania	3,141	3,173	1.32	1.43	4,146	4,537	14.90	15.60	61,775	70,777
Delaware	72	72	1.30	1.33	94	96	15.70	15.00	1,476	1,440
Maryland	390	381	1.26	1.51	491	575	15.20	14.40	7,463	8,280
Virginia	750	741	1.27	1.20	952	889	15.50	15.20	14,756	13,518
West Virginia	740	745	1.25	1.38	925	1,028	14.90	15.00	13,782	15,420
North Carolina	320	293	1.31	1.30	419	381	16.50	16.70	6,914	6,363
South Carolina	210	194	1.16	1.15	244	223	18.70	18.00	4,563	4,014
Georgia	250	234	1.40	1.35	350	316	17.90	17.00	6,265	5,372
Florida	47	43	1.35	1.25	63	54	18.20	18.10	1,147	977
Ohio	2,960	2,960	1.30	1.36	3,848	4,026	12.80	13.00	49,254	52,338
Indiana	1,800	1,885	1.00	1.37	1,800	2,582	14.10	11.40	25,380	29,435
Illinois	2,500	2,512	.98	1.30	2,450	3,266	14.10	12.60	34,545	41,152
Michigan	2,400	2,395	1.05	1.33	2,520	3,185	13.10	12.70	33,012	40,450
Wisconsin	2,375	2,250	1.62	1.60	3,848	3,600	11.10	12.10	42,713	43,560
Minnesota	1,660	1,661	1.50	1.53	2,490	2,541	6.60	6.40	16,434	16,262
Iowa	3,000	3,537	1.48	1.40	4,440	4,952	9.60	9.50	42,624	47,044
Missouri	3,000	3,187	.60	1.30	1,800	4,143	14.50	9.80	26,100	40,601
North Dakota	340	364	1.14	1.40	388	510	5.80	5.50	2,250	2,805
South Dakota	460	460	1.20	1.46	552	672	6.50	6.10	3,588	4,099
Nebraska	1,250	1,150	1.34	1.35	1,675	1,552	8.70	8.40	14,572	13,037
Kansas	1,500	1,627	.90	1.50	1,350	2,440	12.50	7.60	16,875	18,544
Kentucky	775	815	.87	1.23	674	1,002	16.50	13.70	11,121	13,727
Tennessee	900	888	1.21	1.30	1,089	1,154	16.20	15.80	17,642	18,233
Alabama	210	209	1.36	1.25	286	261	14.20	14.60	4,061	3,811
Mississippi	220	201	1.33	1.48	293	297	13.50	12.50	3,956	3,712
Louisiana	160	142	1.50	1.65	240	234	12.50	12.70	3,000	2,972
Texas	400	387	1.16	1.40	464	542	11.80	10.40	5,475	5,637
Oklahoma	450	385	.85	1.25	382	481	10.40	7.40	3,973	3,559
Arkansas	320	286	1.20	1.23	384	352	13.50	12.00	5,184	4,224
Montana	660	640	1.80	1.90	1,188	1,216	9.60	8.30	11,405	10,093
Wyoming	480	452	1.90	1.90	912	859	6.70	8.60	6,110	7,387
Colorado	890	870	2.05	2.19	1,824	1,905	10.00	8.70	18,240	16,574
New Mexico	192	187	2.08	2.33	399	436	12.10	8.50	4,828	3,706
Arizona	135	113	4.00	3.40	540	384	11.00	12.00	5,940	4,608
Utah	390	368	2.33	2.78	909	1,023	9.10	8.00	8,272	8,184
Nevada	235	227	2.75	3.00	646	681	11.00	8.70	7,106	5,925
Idaho	705	692	2.90	2.80	2,044	1,938	7.20	6.30	14,717	12,209
Washington	780	776	2.30	2.20	1,794	1,707	10.90	10.10	19,555	17,241
Oregon	825	790	2.10	2.20	1,732	1,738	9.00	8.30	15,588	14,425
California	2,400	2,500	1.50	1.53	3,600	3,825	13.50	13.70	48,600	52,402
United States	48,954	49,530	1.31	1.47	64,116	72,691	12.43	11.79	797,077	856,695

TABLE 13.—**Winter wheat:** *Estimates of acreage, production, and value, 1913 and 1912.*

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per bushel Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Dolls.*	*Dolls.*
New York	340	335	20.0	16.0	6,800	5,360	93	99	6,324	5,306
New Jersey	80	79	17.6	18.5	1,408	1,462	96	98	1,352	1,433
Pennsylvania	1,286	1,240	17.0	18.0	21,862	22,320	91	95	19,894	21,204
Delaware	113	111	14.5	17.5	1,638	1,942	88	96	1,441	1,864
Maryland	610	599	13.3	15.0	8,113	8,985	89	95	7,221	8,536
Virginia	780	741	13.6	11.6	10,608	8,596	96	101	10,184	8,682
West Virginia	235	233	13.0	14.5	3,055	3,378	100	101	3,055	3,412
North Carolina	605	598	11.7	8.9	7,078	5,322	106	111	7,503	5,907
South Carolina	79	79	12.3	9.2	972	727	130	119	1,264	865
Georgia	140	132	12.2	9.3	1,708	1,228	120	122	2,050	1,498
Ohio	1,950	1,220	18.0	8.0	35,100	9,760	90	98	31,590	9,565
Indiana	2,150	1,260	18.5	8.0	39,775	10,080	88	93	35,002	9,374
Illinois	2,240	1,183	18.7	8.3	41,888	9,819	86	88	36,024	8,641
Michigan	835	700	15.3	10.0	12,776	7,000	89	96	11,371	6,720
Wisconsin	87	87	20.1	19.5	1,749	1,696	82	83	1,434	1,408
Minnesota	50	....	16.2	......	810	....	76	......	616	....
Iowa	450	300	23.4	23.0	10,530	6,900	76	78	8,003	5,382
Missouri	2,315	1,900	17.1	12.5	39,586	23,750	84	90	33,252	21,375
South Dakota	100	....	9.0	......	900	....	71	......	639	....
Nebraska	3,125	2,825	18.6	18.0	58,125	50,850	71	69	41,269	35,086
Kansas	6,655	5,900	13.0	15.5	86,515	91,450	79	74	68,347	67,673
Kentucky	725	686	13.6	10.0	9,860	6,860	96	99	9,466	6,791
Tennessee	700	674	12.0	10.5	8,400	7,077	98	100	8,232	7,077
Alabama	32	30	11.7	10.6	374	318	115	113	430	359
Mississippi	1	8	14.0	12.0	14	96	95	97	13	93
Texas	780	735	17.5	15.0	13,650	11,025	94	93	12,831	10,253
Oklahoma	1,750	1,570	10.0	12.8	17,500	20,096	82	75	14,350	15,072
Arkansas	101	94	13.0	10.0	1,313	940	90	94	1,182	884
Montana	480	475	25.6	24.5	12,288	11,638	66	64	8,110	7,448
Wyoming	40	32	25.0	28.0	1,000	896	72	80	720	717
Colorado	200	193	21.1	24.5	4,220	4,728	78	73	3,292	3,451
New Mexico	35	33	18.6	20.0	651	660	97	90	631	594
Arizona	29	21	32.0	31.0	928	651	110	110	1,021	716
Utah	200	160	23.0	24.0	4,600	3,840	73	75	3,358	2,880
Nevada	16	15	23.0	27.5	368	412	82	100	302	412
Idaho	310	335	27.4	28.7	8,494	9,614	63	66	5,351	6,345
Washington	1,200	988	27.0	27.6	32,400	27,269	73	68	23,652	18,543
Oregon	575	630	21.4	26.8	12,305	16,884	75	72	9,229	12,156
California	300	370	14.0	17.0	4,200	6,290	95	93	3,990	5,850
United States	31,699	26,571	16.5	15.1	523,561	399,919	82.9	80.9	433,995	323,572

TABLE 14.—**Spring wheat:** *Estimates of acreage, production, and value, 1913 and 1912.*

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per bushel Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Dolls.*	*Dolls.*
Maine	3	3	25.5	23.5	76	70	101	103	77	72
Vermont	1	1	24.5	25.0	24	25	100	98	24	24
Wisconsin	103	101	18.6	18.5	1,916	1,868	82	83	1,571	1,550
Minnesota	4,150	4,325	16.2	15.5	67,230	67,038	76	73	51,095	48,938
Iowa	345	350	17.0	17.0	5,865	5,950	76	78	4,457	4,641
North Dakota	7,510	7,990	10.5	18.0	78,855	143,820	73	69	57,564	99,236
South Dakota	3,675	3,675	9.0	14.2	33,075	52,185	71	69	23,483	36,008
Nebraska	350	298	12.0	14.1	4,200	4,202	71	69	2,982	2,899
Kansas	55	56	8.5	15.0	468	840	79	74	370	622
Montana	390	328	21.5	23.5	8,385	7,708	66	64	5,534	4,933

TABLE 14.—**Spring wheat:** *Estimates of acreage, production, and value, 1913 and 1912*—Continued.

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per bushel Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Dolls.*	*Dolls.*
Wyoming	50	44	25.0	29.2	1,250	1,285	72	80	900	1,028
Colorado	260	260	21.0	24.0	5,460	6,240	78	73	4,259	4,555
New Mexico	30	26	19.0	22.0	570	572	97	90	553	515
Arizona	....	2	......	28.0	....	56	......	110	....	62
Utah	65	76	28.0	29.2	1,820	2,219	73	75	1,329	1,664
Nevada	23	24	31.0	30.2	713	725	82	100	585	725
Idaho	200	175	28.0	28.3	5,600	4,952	63	66	3,528	3,268
Washington	1,100	1,297	19.0	20.4	20,900	26,459	73	68	15,257	17,992
Oregon	175	212	19.5	19.5	3,412	4,134	75	72	2,559	2,976
United States	18,485	19,243	13.0	17.2	239,819	330,348	73.4	70.1	176,127	231,708

TABLE 15.—**Wheat:** *Estimates of acreage, production, and value, 1913 and 1912.*

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per bushel Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Dolls.*	*Dolls.*
Maine	3	3	25.5	23.5	76	70	101	103	77	72
Vermont	1	1	24.5	25.0	24	25	100	98	24	24
New York	340	335	20.0	16.0	6,800	5,360	93	99	6,324	5,306
New Jersey	80	79	17.6	18.5	1,408	1,462	96	98	1,352	1,433
Pennsylvania	1,286	1,240	17.0	18.0	21,862	22,320	91	95	19,894	21,204
Delaware	113	111	14.5	17.5	1,638	1,942	88	96	1,441	1,864
Maryland	610	599	13.3	15.0	8,113	8,985	89	95	7,221	8,536
Virginia	780	741	13.6	11.6	10,608	8,596	96	101	10,184	8,682
West Virginia	235	233	13.0	14.5	3,055	3,378	100	101	3,055	3,412
North Carolina	605	598	11.7	8.9	7,078	5,322	106	111	7,503	5,907
South Carolina	79	79	12.3	9.2	972	727	130	119	1,264	865
Georgia	140	132	12.2	9.3	1,708	1,228	120	122	2,050	1,498
Ohio	1,950	1,220	18.0	8.0	35,100	9,760	90	98	31,590	9,565
Indiana	2,150	1,260	18.5	8.0	39,775	10,080	88	93	35,002	9,374
Illinois	2,240	1,183	18.7	8.3	41,888	9,819	86	88	36,024	8,641
Michigan	835	700	15.3	10.0	12,776	7,000	89	96	11,371	6,720
Wisconsin	190	188	19.3	19.0	3,666	3,564	82	83	3,005	2,958
Minnesota	4,200	4,325	16.2	15.5	68,040	67,038	76	73	51,711	48,938
Iowa	796	650	20.6	19.8	16,396	12,850	76	78	12,460	10,023
Missouri	2,315	1,900	17.1	12.5	39,586	23,750	84	90	33,252	21,375
North Dakota	7,510	7,990	10.5	18.0	78,855	143,820	73	69	57,564	99,236
South Dakota	3,775	3,675	9.0	14.2	33,975	52,185	71	69	24,122	36,008
Nebraska	3,475	3,123	17.9	17.6	62,325	55,052	71	69	44,251	37,985
Kansas	6,710	5,956	13.0	15.5	86,983	92,290	79	74	68,717	68,295
Kentucky	725	686	13.6	10.0	9,860	6,860	96	99	9,466	6,791
Tennessee	700	674	12.0	10.5	8,400	7,077	98	100	8,232	7,077
Alabama	32	30	11.7	10.6	374	318	115	113	430	359
Mississippi	1	8	14.0	12.0	14	96	95	97	13	93
Texas	780	735	17.5	15.0	13,650	11,025	94	93	12,831	10,253
Oklahoma	1,750	1,570	10.0	12.8	17,500	20,096	82	75	14,350	15,072
Arkansas	101	94	13.0	10.0	1,313	940	90	94	1,182	884
Montana	870	803	23.8	24.1	20,673	19,346	66	64	13,644	12,381
Wyoming	90	76	25.0	28.7	2,250	2,181	72	80	1,620	1,745
Colorado	460	453	21.0	24.2	9,680	10,968	78	73	7,551	8,006
New Mexico	65	59	18.8	20.9	1,221	1,232	97	90	1,184	1,109
Arizona	29	23	32.0	30.7	928	707	110	110	1,021	778
Utah	265	236	24.2	25.7	6,420	6,059	73	75	4,687	4,544
Nevada	39	39	27.7	29.2	1,081	1,137	82	100	887	1,137
Idaho	510	510	27.6	28.6	14,094	14,566	63	66	8,879	9,613
Washington	2,300	2,285	23.2	23.5	53,300	53,728	73	68	38,909	36,535
Oregon	750	842	21.0	25.0	15,717	21,018	75	72	11,788	15,132
California	300	370	14.0	17.0	4,200	6,290	95	93	3,990	5,850
United States	50,184	45,814	15.2	15.9	763,380	730,267	79.9	76.0	610,122	555,280

TABLE 16.—**Oats:** *Estimates of acreage, production, and value, 1913 and 1912.*

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per bushel Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Dolls.*	*Dolls.*
Maine	140	133	40	35	5,600	4,602	55	51	3,080	2,347
New Hampshire	12	12	35	39	420	468	56	48	235	225
Vermont	79	77	39	43	3,081	3,311	52	48	1,602	1,589
Massachusetts	9	8	35	34	315	272	54	47	170	128
Rhode Island	2	2	26	29	52	57	50	45	26	26
Connecticut	11	11	28	31	308	338	55	49	169	166
New York	1,275	1,192	34	31	42,712	36,714	47	42	20,075	15,420
New Jersey	70	67	29	28	2,030	1,849	47	44	954	814
Pennsylvania	1,154	1,099	31	33	35,774	36,377	46	41	16,456	14,915
Delaware	4	4	30	30	122	122	51	45	62	55
Maryland	45	45	28	30	1,260	1,350	48	45	605	608
Virginia	195	175	22	22	4,192	3,885	52	52	2,180	2,020
West Virginia	115	111	24	28	2,760	3,108	51	47	1,408	1,461
North Carolina	230	204	20	19	4,485	3,794	61	62	2,736	2,352
South Carolina	360	324	24	22	8,460	6,966	71	66	6,007	4,598
Georgia	420	364	22	21	9,240	7,571	68	65	6,283	4,921
Florida	50	43	18	17	900	740	70	70	630	518
Ohio	1,800	2,120	30	44	54,360	93,280	40	33	21,744	30.782
Indiana	1,700	1,990	21	40	36,380	79,799	38	30	13,824	23.940
Illinois	4,375	4,220	24	43	104,125	182,726	38	30	39,568	54,818
Michigan	1,500	1,485	30	35	45,000	51,826	39	33	17,550	17,103
Wisconsin	2,275	2,272	36	37	83,038	84,746	37	32	30,724	27,119
Minnesota	2,980	2,948	38	42	112,644	122,932	32	26	36,046	31,962
Iowa	4,880	4,928	34	44	168,360	217,818	34	27	57,242	58,811
Missouri	1,250	1,125	21	33	26,500	37,125	45	35	11,925	12,994
North Dakota	2,250	2,300	26	41	57,825	95,220	30	22	17,348	20.948
South Dakota	1,590	1,550	26	34	42,135	52,390	34	25	14,326	13.098
Nebraska	2,250	2,275	26	24	59,625	55,510	38	30	22,658	16.653
Kansas	1,760	1,720	20	32	34,320	55,040	45	35	15,444	19,264
Kentucky	160	150	20	27	3,168	4,035	52	44	1,647	1,775
Tennessee	300	258	21	22	6,300	5,599	53	47	3,339	2,632
Alabama	325	260	20	20	6,662	5.200	69	62	4,597	3,224
Mississippi	140	113	20	17	2,800	1,966	63	60	1,764	1,180
Louisiana	45	34	22	21	990	707	57	51	564	361
Texas	1,000	865	32	36	32,500	31,140	51	43	16,575	13,390
Oklahoma	1,030	936	18	25	18,540	23,494	45	34	8,343	7,988
Arkansas	240	175	26	20	6,360	3,482	53	50	3,371	1,741
Montana	500	476	44	48	21,750	22,848	32	35	6,960	7.997
Wyoming	220	205	38	42	8,360	8,569	40	37	3,344	3.171
Colorado	305	290	35	43	10,675	12,412	44	38	4,697	4,717
New Mexico	50	53	30	35	1,500	1,839	60	45	900	828
Arizona	7	6	43	45	301	268	50	70	150	188
Utah	90	91	46	46	4,140	4.222	40	49	1,656	2,069
Nevada	11	10	43	40	473	400	65	52	307	208
Idaho	325	348	46	49	15,112	17,017	32	35	4,836	5,956
Washington	300	284	48	48	14,250	13,689	40	40	5,700	5,476
Oregon	360	359	42	38	15,228	13,714	38	41	5,787	5.623
California	210	200	32	39	6,636	7,800	60	55	3,982	4,290
United States.	38,399	37,917	29.2	37.4	1,121,768	1,418,337	39.2	31.9	439,596	452,469

TABLE 17.—**Potatoes:** *Estimates of acreage, production, and value, 1913 and 1912.*

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per bushel Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Dolls.*	*Dolls.*
Maine	128	117	220	198	28,160	23,166	53	55	14,925	12,741
New Hampshire	17	17	122	140	2,074	2,380	83	61	1,721	1,452
Vermont	25	26	127	140	3,175	3,640	72	55	2,286	2,002
Massachusetts	27	26	105	130	2,835	3,380	85	75	2,410	2,535
Rhode Island	5	5	130	113	650	565	90	77	585	435
Connecticut	24	23	92	107	2,208	2,461	87	78	1,921	1,920
New York	360	360	74	106	26,640	38,160	80	58	21,312	22,133
New Jersey	94	92	95	108	8,930	9,936	82	66	7,323	6,558
Pennsylvania	265	265	88	109	23,320	28,885	80	57	18,656	16,464
Delaware	11	11	87	100	957	1,100	75	70	718	770
Maryland	43	37	87	112	3,741	4,144	67	58	2,506	2,404
Virginia	105	95	94	87	9,870	8,265	80	65	7,896	5,372
West Virginia	48	47	83	112	3,984	5,264	90	62	3,586	3,264
North Carolina	30	30	80	85	2,400	2,550	82	76	1,968	1,938
South Carolina	10	10	80	90	800	900	130	112	1,040	1,008
Georgia	12	12	81	78	972	936	105	87	1,021	814
Florida	12	11	76	93	912	1,023	117	110	1,067	1,125
Ohio	160	186	64	112	10,240	20,832	85	53	8,704	11,041
Indiana	75	87	53	114	3,975	9,918	84	50	3,339	4,959
Illinois	125	137	46	101	5,750	13,837	89	60	5,118	8,302
Michigan	350	350	96	105	33,600	36,750	53	41	17,808	15,068
Wisconsin	295	291	109	120	32,155	34,920	54	34	17,364	11,873
Minnesota	275	245	110	135	30,250	33,075	52	28	15,730	9,261
Iowa	150	174	48	109	7,200	18,966	82	46	5,904	8,724
Missouri	85	95	38	84	3,230	7,980	93	69	3,004	5,506
North Dakota	60	52	85	128	5,100	6,656	56	28	2,856	1,864
South Dakota	60	62	78	105	4,680	6,510	63	36	2,948	2,344
Nebraska	118	118	48	80	5,664	9,440	78	51	4,418	4,814
Kansas	73	70	40	82	2,920	5,740	91	73	2,657	4,190
Kentucky	50	51	49	101	2,450	5,151	102	67	2,499	3,451
Tennessee	38	38	64	88	2,432	3,344	97	70	2,359	2,341
Alabama	18	15	84	81	1,512	1,215	105	90	1,588	1,094
Mississippi	12	10	80	89	960	890	100	90	960	801
Louisiana	25	20	70	73	1,750	1,460	96	83	1,680	1,212
Texas	45	52	52	63	2,340	3,276	112	105	2,621	3,440
Oklahoma	32	29	60	60	1,920	1,740	105	93	2,016	1,618
Arkansas	25	25	72	70	1,800	1,750	100	92	1,800	1,610
Montana	36	37	140	165	5,040	6,105	67	40	3,377	2,442
Wyoming	12	11	140	140	1,680	1,540	65	60	1,092	924
Colorado	80	85	115	95	9,200	8,075	65	41	5,980	3,311
New Mexico	9	9	68	100	612	900	140	65	857	585
Arizona	1	1	75	125	75	125	135	125	101	156
Utah	20	19	180	185	3,600	3,515	58	49	2,088	1,722
Nevada	11	12	160	178	1,760	2,136	68	60	1,197	1,282
Idaho	34	35	170	185	5,780	6,475	50	29	2,890	1,878
Washington	60	68	123	167	7,380	11,356	60	36	4,428	4,088
Oregon	50	65	135	155	6,750	10,075	58	31	3,915	3,123
California	68	78	119	130	8,092	10,140	70	65	5,664	6,591
United States	3,668	3,711	90.4	113.4	331,525	420,647	68.7	50.5	227,903	212,550

TABLE 18.—**Cotton:** *Estimates of acreage, production, and value, 1913 and 1912.*

[All 1913 figures are preliminary. Figures of acreage in 1913 are estimates made in December, 1913, and subject to revision in May, 1914.]

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per pound Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Lbs.*	*Lbs.*	*Bales.*[1]	*Bales.*[1]	*Cts.*	*Cts.*	*Dolls.*	*Dolls.*
Virginia	48	47	250	250	25	24	13.1	12.0	1,562	1,397
North Carolina	1,526	1,545	239	267	765	865	12.6	12.2	45,959	50,373
South Carolina	2,701	2,695	235	209	1,330	1,182	12.7	12.4	80,621	69,963
Georgia	5,328	5,335	204	159	2,275	1,776	12.8	12.4	139,135	105,286
Florida	218	224	150	113	68	52	17.0	15.7	5,564	3,980
Missouri	111	103	286	260	66	55	11.5	11.3	3,636	3,014
Tennessee	872	783	206	169	375	276	12.7	12.4	22,803	16,416
Alabama	3,800	3,730	190	172	1,510	1,342	12.7	12.1	91,704	77,681
Mississippi	2,963	2,889	193	173	1,195	1,046	12.6	12.3	72,048	61,687
Louisiana	1,126	929	170	193	400	376	11.7	11.5	22,389	20,678
Texas	12,072	11,338	156	206	3,930	4,880	11.5	11.5	216,574	268,883
Oklahoma	3,019	2,665	130	183	820	1,021	11.4	11.3	44,740	55,241
Arkansas	2,210	1,991	195	190	900	792	11.6	12.3	49,987	46,627
California	17	9	500	......	18	....	13.0	......	1,119	....
United States	36,011	34,283	182	191	13,677	[2] 13,703	12.2	11.9	797,841	[2] 781,806

[1] Bales of 500 pounds gross weight.

[2] Includes "All other."

TABLE 19.—**Tobacco:** *Estimates of acreage, production, and value, 1913 and 1912.*

States.	Acreage.		Yield per acre.		Total production (000 omitted).		Price per pound Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Cts.*	*Cts.*	*Dollars.*	*Dollars.*
New Hampshire	100	100	1,650	1,700	165	170	18.0	18.5	30	31
Vermont	100	100	1,550	1,700	155	170	18.0	18.5	28	31
Massachusetts	6,100	5,800	1,550	1,700	9,455	9,860	21.0	23.9	1,986	2,357
Connecticut	18,400	17,500	1,550	1,700	28,520	29,750	21.0	24.1	5,989	7,170
New York	4,300	4,000	1,020	1,300	4,386	5,200	12.2	12.6	535	655
Pennsylvania	38,900	44,200	1,200	1,450	46,680	64,090	7.5	8.5	3,501	5,448
Maryland	25,000	26,000	740	660	18,500	17,160	9.3	8.0	1,720	1,373
Virginia	200,000	187,000	770	600	154,000	112,200	13.9	12.0	21,406	13,464
West Virginia	15,000	15,800	680	760	10,200	12,008	12.0	11.0	1,224	1,321
North Carolina	250,000	179,000	670	620	167,500	110,980	18.5	16.0	30,988	17,757
South Carolina	43,800	35,000	760	700	33,288	24,500	13.8	10.9	4,594	2,670
Georgia	1,800	1,400	1,000	830	1,800	1,162	31.0	30.0	558	349
Florida	4,000	3,100	1,000	840	4,000	2,604	31.0	30.0	1,240	781
Ohio	81,900	86,200	750	920	61,425	79,304	11.4	9.1	7,002	7,217
Indiana	15,900	18,700	750	800	11,925	14,960	11.0	9.0	1,312	1,346
Illinois	800	900	700	760	560	684	11.5	9.0	64	62
Wisconsin	43,000	42,200	1,180	1,290	50,740	54,438	12.0	11.0	6,089	5,988
Missouri	5,100	6,000	650	1,000	3,315	6,000	12.7	12.0	421	720
Kentucky	370,000	441,000	760	780	281,200	343,980	10.0	8.7	28,120	29,926
Tennessee	90,000	110,000	720	660	64,800	72,600	8.4	7.1	5,443	5,155
Alabama	300	300	700	750	210	225	25.0	35.0	52	79
Louisiana	600	500	450	300	270	150	25.0	30.0	68	45
Texas	200	200	600	700	120	140	22.0	17.5	26	24
Arkansas	800	800	650	650	520	520	16.4	18.0	85	94
United States	1,216,100	1,225,800	784.3	785.5	953,734	962,855	12.8	10.8	122,481	104,063

TABLE 20.—**Rye:** *Estimates of acreage, production, and value, 1913 and 1912.*

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per bushel Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Dollars.*	*Dollars.*
Vermont	1	1	18.0	20.0	18	20	90	90	16	18
Massachusetts	3	3	18.5	18.5	56	56	98	100	55	56
Connecticut	7	7	19.3	17.5	135	122	92	92	124	112
New York	133	128	17.2	16.5	2,288	2,112	75	76	1,716	1,606
New Jersey	70	72	18.0	17.5	1,260	1,260	80	79	1,008	996
Pennsylvania	280	282	17.5	17.5	4,900	4,935	74	77	3,626	3,800
Delaware	1	1	14.0	14.0	14	14	79	81	11	11
Maryland	27	27	14.4	15.5	389	418	76	80	296	334
Virginia	58	48	12.3	12.5	713	600	81	85	578	510
West Virginia	17	17	13.5	13.0	230	221	87	84	200	186
North Carolina	46	44	10.3	9.3	474	409	98	105	465	429
South Carolina	3	3	10.5	9.5	32	28	150	145	48	41
Georgia	13	11	9.5	9.2	124	101	135	140	167	141
Ohio	97	57	16.5	15.5	1,600	884	69	75	1,104	663
Indiana	103	64	15.2	14.5	1,566	928	62	68	971	631
Illinois	49	48	16.5	16.0	808	768	65	70	525	538
Michigan	375	370	14.3	13.3	5,362	4,921	62	65	3,324	3,199
Wisconsin	425	341	17.5	18.3	7,438	6,240	57	61	4,240	3,806
Minnesota	300	262	19.0	23.0	5,700	6,026	48	50	2,736	3,013
Iowa	60	35	18.2	19.0	1,092	665	60	62	655	412
Missouri	16	15	15.0	14.8	240	222	75	80	180	178
North Dakota	125	48	14.4	18.0	1,800	864	45	47	810	406
South Dakota	50	16	13.2	19.5	660	312	50	52	330	162
Nebraska	120	55	14.5	16.0	1,740	880	60	56	1,044	493
Kansas	45	30	14.0	15.9	630	477	75	68	472	324
Kentucky	22	21	12.4	13.0	273	273	87	88	238	240
Tennessee	17	17	12.0	11.5	204	196	99	98	202	192
Alabama	1	1	11.0	11.5	11	12	140	134	15	16
Texas	2	2	15.0	16.6	30	33	101	110	30	36
Oklahoma	5	4	9.5	12.0	48	48	86	87	41	42
Arkansas	1	1	11.5	10.5	12	10	95	105	11	10
Montana	10	10	21.0	23.5	210	235	55	60	116	141
Wyoming	4	3	19.0	19.0	76	57	64	65	49	37
Colorado	20	25	17.0	19.5	340	488	60	55	204	268
Utah	12	6	17.0	15.0	204	90	60	66	122	61
Idaho	3	3	22.0	22.0	66	66	58	60	38	40
Washington	8	9	21.0	20.0	168	180	60	65	101	117
Oregon	20	22	17.5	16.0	350	352	75	70	262	246
California	8	8	15.0	17.6	120	141	75	90	90	127
United States	2,557	2,117	16.2	16.8	41,381	35,664	63.4	66.3	26,220	23,636

TABLE 21.—**Barley:** *Estimates of acreage, production, and value, 1913 and 1912.*

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per bushel Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Dolls.*	*Dolls.*
Maine	5	4	28	26	140	105	80	77	112	81
New Hampshire	1	1	28	28	28	28	80	84	22	24
Vermont	12	13	32	35	384	455	80	80	307	364
New York	77	82	27	26	2,056	2,132	69	68	1,419	1,450
Pennsylvania	7	7	26	28	182	192	71	68	129	131
Maryland	5	4	29	27	145	108	64	68	93	73
Virginia	11	10	26	25	286	250	70	75	200	188
Ohio	40	20	24	31	960	620	58	55	557	341
Indiana	8	9	25	30	200	266	50	60	100	160
Illinois	54	57	26	32	1,404	1,796	57	53	800	952
Michigan	85	87	25	26	2,108	2,262	60	65	1,265	1,470
Wisconsin	725	845	25	29	18,125	24,843	60	55	10,875	13,664
Minnesota	1,450	1,490	24	28	34,800	42,018	48	41	16,704	17,227
Iowa	400	470	25	31	10,000	14,570	55	52	5,500	7,576
Missouri	5	6	22	25	110	149	60	66	66	98
North Dakota	1,275	1,176	20	30	25,500	35,162	40	35	10,200	12,307
South Dakota	958	887	18	26	16,765	23,062	46	42	7,712	9,686
Nebraska	110	113	16	22	1,760	2,486	49	42	862	1,044
Kansas	240	176	8	24	1,944	4,136	55	40	1,069	1,654
Kentucky	3	3	27	26	80	78	78	75	62	58
Tennessee	2	2	25	26	50	52	70	80	35	42
Texas	7	6	24	29	168	176	81	78	136	137
Oklahoma	7	8	9	20	63	160	80	50	50	80
Montana	60	39	31	36	1,860	1,424	48	53	893	755
Wyoming	13	11	30	34	396	374	61	62	242	232
Colorado	100	76	32	39	3,250	2,964	56	50	1,820	1,482
New Mexico	4	2	24	35	96	70	72	71	69	50
Arizona	38	36	39	40	1,482	1,440	73	87	1,082	1,253
Utah	30	25	38	45	1,155	1,125	55	59	635	664
Nevada	12	12	41	41	492	492	90	87	443	428
Idaho	180	159	42	44	7,560	6,916	48	51	3,629	3,527
Washington	180	183	40	43	7,290	7,869	52	53	3,791	4,171
Oregon	120	119	35	36	4,200	4,284	55	55	2,310	2,356
California	1,275	1,392	26	30	33,150	41,760	68	70	22,542	29,232
United States	7,499	7,530	23.8	29.7	178,189	223,824	53.7	50.5	95,731	112,957

TABLE 22.—**Rice:** *Estimates of acreage, production, and value, 1913 and 1912.*

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per bushel Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Dolls.*	*Dolls.*
North Carolina	300	400	24	25	7	10	80	90	6	9
South Carolina	4,900	8,000	30	25	147	200	90	93	132	186
Georgia	500	900	32	30	16	27	83	90	13	24
Florida	400	600	25	25	10	15	60	90	6	14
Alabama	200	300	22	30	4	9	60	90	2	8
Mississippi	1,500	2,200	28	35	42	77	70	90	29	69
Louisiana	405,500	352,600	29	34	11,760	11,812	84	93	9,878	10,985
Texas	303,000	265,600	32	36	9,696	9,429	86	94	8,339	8,863
Arkansas	104,700	90,800	36	38	3,769	3,405	90	94	3,392	3,201
California	6,100	1,400	48	50	293	70	100	91	293	64
United States	827,100	722,800	31.1	34.7	25,744	25,054	85.8	93.5	22,090	23,423

TABLE 23.—**Sweet potatoes:** *Estimates of acreage, production, and value, 1913 and 1912.*

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per bushel Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Dolls.*	*Dolls.*
New Jersey	23	23	138	120	3,174	2,760	78	84	2,476	2,318
Pennsylvania	1	1	110	120	110	120	90	75	99	90
Delaware	5	5	135	120	675	600	60	68	405	408
Maryland	8	8	141	125	1,128	1,000	60	63	677	630
Virginia	33	33	108	90	3,564	2,970	70	75	2,495	2,228
West Virginia	2	2	91	115	182	230	100	90	182	207
North Carolina	80	75	100	90	8,000	6,750	61	62	4,880	4,185
South Carolina	50	48	92	105	4,600	5,040	75	68	3,450	3,427
Georgia	83	81	87	90	7,221	7,290	68	66	4,910	4,811
Florida	21	21	110	112	2,310	2,352	75	73	1,732	1,717
Ohio	1	1	90	118	90	118	106	87	95	103
Indiana	1	1	78	116	78	116	103	89	80	103
Illinois	8	8	70	98	560	784	106	95	594	745
Iowa	2	2	80	90	160	180	150	108	240	194
Missouri	6	6	56	88	336	528	105	95	353	502
Kansas	5	5	50	99	250	495	110	103	275	510
Kentucky	9	9	75	90	675	810	94	85	634	688
Tennessee	20	20	80	90	1,600	1,800	80	72	1,280	1,296
Alabama	70	62	95	100	6,650	6,200	67	71	4,456	4,402
Mississippi	55	52	98	97	5,390	5,044	62	62	3,342	3,127
Louisiana	60	56	85	84	5,100	4,704	70	65	3,570	3,058
Texas	50	36	80	75	4,000	2,700	95	104	3,800	2,808
Oklahoma	6	4	64	92	384	368	104	109	399	401
Arkansas	20	18	90	88	1,800	1,584	80	90	1,440	1,426
California	6	6	170	156	1,020	936	100	94	1,020	880
United States	625	583	92.5	95.2	59,057	55,479	72.6	72.6	42,884	40,264

TABLE 24.—**Flaxseed:** *Estimates of acreage, production, and value, 1913 and 1912.*

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per bushel Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*
Wisconsin	9	10	14.0	12.5	126	125	1.23	1.27	155	159
Minnesota	350	404	9.0	10.2	3,150	4,121	1.23	1.20	3,874	4,945
Iowa	28	35	9.4	11.5	263	402	1.23	1.24	323	498
Missouri	10	12	5.0	6.0	50	72	1.15	1.10	58	79
North Dakota	1,000	1,246	7.2	9.7	7,200	12,086	1.21	1.14	8,712	13,778
South Dakota	425	619	7.2	8.6	3,060	5,323	1.20	1.13	3,672	6,015
Nebraska	9	2	6.0	9.5	54	19	1.10	1.28	59	24
Kansas	50	50	6.0	6.0	300	300	1.16	1.30	348	390
Oklahoma	....	1	......	9.0	....	9	......	1.38	....	12
Montana	400	460	9.0	12.0	3,600	5,520	1.15	1.12	4,140	6,182
Colorado	10	12	5.0	8.0	50	96	1.15	1.25	58	120
United States	2,291	2,851	7.8	9.8	17,853	28,073	1.20	1.15	21,399	32,202

TABLE 25.—**Buckwheat:** *Estimates of acreage, production, and value, 1913 and 1912.*

States.	Acreage (000 omitted).		Yield per acre.		Total production (000 omitted).		Price per bushel Dec. 1 to producers.		Value based on prices Dec. 1 to producers (000 omitted).	
	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912
	Acres.	*Acres.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cts.*	*Cts.*	*Dolls.*	*Dolls.*
Maine	13	14	32.0	29.4	416	412	56	70	233	288
New Hampshire	1	1	31.0	31.0	31	31	66	72	20	22
Vermont	8	8	25.0	30.0	200	240	80	72	160	173
Massachusetts	2	2	17.0	21.0	34	42	80	85	27	36
Connecticut	3	3	17.0	20.5	51	62	95	88	48	55
New York	280	277	14.3	23.8	4,004	6,593	81	64	3,243	4,220
New Jersey	10	12	22.0	22.0	220	264	76	72	167	190
Pennsylvania	280	306	18.5	24.2	5,180	7,405	73	64	3,781	4,739
Delaware	3	4	17.0	16.0	51	64	69	66	35	42
Maryland	11	12	16.5	17.5	182	210	75	71	136	149
Virginia	23	24	23.1	21.5	531	516	80	75	425	387
West Virginia	38	37	21.0	24.0	798	888	78	75	622	666
North Carolina	9	10	19.3	17.5	174	175	78	85	136	149
Ohio	18	21	18.0	19.5	324	410	76	70	246	287
Indiana	5	5	18.5	19.0	92	95	75	73	69	69
Illinois	4	4	17.0	22.0	68	88	80	80	54	70
Michigan	60	64	15.0	17.0	900	1,088	70	65	630	707
Wisconsin	18	17	16.5	17.0	297	290	69	66	205	191
Minnesota	6	6	16.5	21.0	99	126	64	65	63	82
Iowa	6	7	14.0	19.0	84	133	81	75	68	100
Missouri	2	2	11.0	15.0	22	30	85	95	19	28
Nebraska	1	1	20.0	18.0	20	18	79	90	16	16
Kansas	1	1	10.0	16.0	10	16	80	78	8	12
Tennessee	3	3	15.0	18.0	45	54	75	78	34	42
United States	805	841	17.2	22.9	13,833	19,249	75.5	66.1	10,445	12,720

TABLE 26.—**Winter wheat and rye:** *Estimates of acreage planted autumn, 1913, and condition Dec. 1, with comparisons.*

States.	Winter wheat.						Rye.					
	Area sown.			Condition Dec. 1.			Area sown.			Condition Dec. 1.		
	Autumn 1912, revised (000 omitted).	Autumn 1913. Compared with 1912.	Autumn 1913. Total preliminary (000 omitted).	1913	1912	10-year average.	Autumn 1912, revised (000 omitted).	Autumn 1913. Compared with 1912.	Autumn 1913. Total preliminary (000 omitted).	1913	1912	10-year average.
	Acres.	*P. ct.*	*Acres.*	*P. ct.*	*P. ct.*	*P. ct.*	*Acres.*	*P. ct.*	*Acres.*	*P. ct.*	*P. ct.*	*P. ct.*
Vermont	....	....	....	....	....	....	1	101	1	92	99	95
Massachusetts	....	....	....	....	....	....	4	101	4	98	97	96
Connecticut	....	....	....	....	....	....	8	102	8	98	98	96
New York	347	105	364	98	94	95	140	100	140	97	96	95
New Jersey	83	100	83	95	98	93	78	101	79	96	97	95
Pennsylvania	1,326	101	1,339	97	95	91	292	100	292	97	97	92
Delaware	116	100	116	95	94	90	1	99	1	96	95	92
Maryland	621	100	621	95	93	89	28	100	28	95	93	90
Virginia	794	100	794	95	92	87	68	100	68	97	91	88
West Virginia	243	99	241	95	91	87	18	99	18	94	89	89
North Carolina	621	101	627	95	92	89	54	102	55	97	93	90
South Carolina	82	100	82	95	94	91	3	103	3	97	96	93
Georgia	144	100	144	92	94	92	14	100	14	93	95	94
Ohio	2,017	105	2,118	99	95	86	103	92	95	97	93	89
Indiana	2,228	113	2,518	98	93	87	110	95	104	97	94	92

Table 26.—Winter wheat and rye: *Estimates of acreage planted autumn, 1913, and condition Dec. 1, with comparisons*—Continued.

States.	Winter wheat.						Rye.					
	Area sown.			Condition Dec. 1.			Area sown.			Condition Dec. 1.		
	Autumn 1912, revised (000 omitted).	Autumn 1913.		1913	1912	10-year average.	Autumn 1912, revised (000 omitted).	Autumn 1913.		1913	1912	10-year average.
		Compared with 1912.	Total preliminary (000 omitted).					Compared with 1912.	Total preliminary (000 omitted).			
	Acres.	*P. ct.*	*Acres.*	*P. ct.*	*P. ct.*	*P. ct.*	*Acres.*	*P. ct.*	*Acres.*	*P. ct.*	*P. ct.*	*P. ct.*
Illinois	2,286	115	2,629	99	94	87	53	99	52	97	95	93
Michigan	874	103	900	95	90	89	399	95	379	96	91	91
Wisconsin	91	98	89	94	93	94	447	100	447	96	95	95
Minnesota	50	90	45	92	......	......	312	95	296	93	92	92
Iowa	466	105	489	96	93	93	62	99	61	97	95	96
Missouri	2,350	110	2,585	98	95	89	18	115	21	99	94	92
North Dakota	......	......	......	......	......	......	132	108	143	91	86	90
South Dakota	100	80	80	80	......	......	54	105	57	87	89	91
Nebraska	3,189	102	3,253	86	96	94	124	95	118	86	95	93
Kansas	7,500	111	8,325	100	92	89	48	115	55	99	95	91
Kentucky	763	100	763	98	85	87	31	100	31	99	85	87
Tennessee	723	100	723	96	89	88	24	105	25	97	88	90
Alabama	33	103	34	92	88	92	2	105	2	95	90	91
Mississippi	1	100	1	91	85	90	......	......	......	......	......	......
Texas	876	130	1,139	102	83	86	2	102	2	101	81	87
Oklahoma	1,882	135	2,541	103	92	85	6	150	9	105	90	88
Arkansas	103	105	108	99	91	86	1	105	1	100	94	86
Montana	516	98	506	91	95	96	11	95	10	95	95	95
Wyoming	42	102	43	97	95	96	4	108	4	98	98	97
Colorado	211	100	211	91	97	92	22	96	21	89	94	93
New Mexico	41	110	45	98	88	......	......	......	......	......	......	......
Arizona	31	105	33	96	99	......	......	......	......	......	......	......
Utah	219	105	230	96	96	95	13	110	14	97	97	98
Nevada	18	105	19	99	99	97	......	......	......	......	......	......
Idaho	326	106	346	97	96	97	3	98	3	96	98	97
Washington	1,271	99	1,258	93	100	94	9	101	9	97	99	97
Oregon	605	105	635	100	97	96	21	100	21	100	99	97
California	429	100	429	100	91	91	11	96	11	100	93	94
United States	33,618	108.6	36,506	97.2	93.2	89.2	2,731	98.9	2,702	95.3	93.5	92.7

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TOBACCO CULTURE.

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INTRODUCTION.

The tobacco plant may be grown successfully in all latitudes from southern Canada to the Tropics and on a great variety of soils, but the commercial value of the product is influenced to a greater degree by the particular soil and climatic conditions under which the plant is grown than is almost any other important crop. These facts are so well recognized that the tobacco industry has become highly specialized, and the trade regularly looks to certain well-defined areas of production for its supply of the various classes and types of leaf required. In these tobacco-producing districts the necessary facilities for marketing are available, and prevailing prices of the cured leaf are governed largely by the relative supply and demand and by the quality of the leaf produced.

Each important district produces a tobacco of certain well-known characteristics which make it desirable for special purposes of manufacture or export. Moreover, in practically all of these districts the production can be readily increased to meet any increased demand at profitable prices. For these reasons efforts to introduce the commercial growing of tobacco in sections outside of the established producing centers are likely to result in failure, either because the leaf produced is not quite right in type or satisfactory marketing facilities are not available. Furthermore, any development of the industry in a new section on a large scale, which would be essential for economical marketing, would most likely lead to overproduction and, as a consequence, unprofitable prices. As a matter of fact, overproduction is a constant menace in all of the established centers of tobacco growing.

The methods of growing and handling the crop must be varied according to the type of leaf which it is desired to produce, for the kind of tobacco obtained is influenced very greatly by the methods of growing and handling which are employed. The methods for the production of the various types briefly outlined in the present bulletin, though possibly susceptible of improvement in some of the details, are the best that can be recommended in view of the present knowledge and experience of investigators and the more successful growers.

CLASSES AND TYPES OF TOBACCO.

As is well known, tobacco is manufactured into various forms for consumption, but large quantities also are exported in an unmanufactured state, so that we may distinguish three general classes of tobacco, i. e., (1) cigar tobaccos, (2) export tobaccos, and (3) manufacturing tobaccos. By manufacturing tobaccos are meant all types used in manufactures other than cigars. The manufacturing and export classes, however, have much in common as regards cultural methods, and some types are used both for manufacturing and for export; therefore these two classes will be considered together as distinguished from the cigar tobaccos.

Each of these three classes of tobacco may be subdivided into types, depending on their special uses, methods of growing and curing, or on the variety of seed used. In the case of cigar tobaccos there are three principal types, corresponding to the three parts of the cigar—wrapper leaf, binder leaf, and filler leaf. In the manufacturing and export tobaccos are such types as the flue-cured, Virginia sun-cured, White Burley, dark fire-cured, etc. These various types are produced on certain special types of soil and according to definite methods of growing, curing, and handling the crop. In some cases the variety of seed used is also an important factor. The special uses of the principal types embraced in the three fundamental classes of tobacco are brought out in connection with the cultural directions for the more important types.

THE CULTURE OF CIGAR TOBACCOS.

While cultural methods in their application to the different cigar-tobacco types and districts may be modified to advantage in some of the details, the essential features are more or less similar, so that it will suffice to outline the most approved methods for the Connecticut Valley, and only the more important differences in cultural methods to be followed in the remaining districts need be mentioned.

CIGAR-LEAF TOBACCO VARIETIES.

There are three important varieties or groups of varieties used in growing cigar tobaccos in this country, i. e., the Broadleaf, or Seedleaf, group; the Havana Seed group; and the Cuban group. The typical Broadleaf, or Seedleaf. is the Connecticut Broadleaf, extensively grown in the Connecticut Valley for wrappers. Acclimated strains of this variety have been developed and are grown in all the northern cigar-leaf States for the production of binder and filler leaf, and in each case these strains are given the name of the State in which they are grown. Thus, we have the Pennsylvania Broadleaf, or Seedleaf; the Ohio Broadleaf, or Seedleaf, etc.

The Connecticut Havana, or Havana Seed, also is extensively grown in the Connecticut Valley for wrapper and binder leaf purposes, and in other northern cigar-tobacco districts for binder leaf, and to some extent for filler leaf. The name "Havana Seed" usually is applied to this variety as grown in any of the northern cigar-tobacco districts, but it is preferable in each case to prefix the name of the State in which it is grown, as is done with the Broadleaf group. There is an important group of so-called Spanish varieties, extensively grown for binder and filler leaf purposes, which are very closely related to or identical with the Havana Seed. The two most important members of this group are Zimmer Spanish, principally grown for filler in the Miami Valley of Ohio, and the Comstock Spanish, chiefly grown for binder leaf in Wisconsin. Zimmer Spanish as grown in Ohio is markedly different in quality from Connecticut Havana as grown in New England, but when the two are grown side by side it is practically impossible to distinguish the one from the other.

Another variety of some local importance in the Miami Valley of Ohio is known as "Little Dutch," of which there are several strains. This variety, which relatively is narrow leaved, is thought to have been introduced from Germany.

The Cuban group is composed of strains or selections obtained from imported seed. Seed imported from Cuba is usually found to be composed of several distinct subvarieties. The Cuban is the only variety of much importance in the southern cigar-tobacco districts, where it is grown both for wrappers and for fillers, although the Sumatra variety formerly was extensively grown for wrapper leaf. In the Connecticut Valley a considerable acreage of Cuban tobacco for the production of wrapper leaf is grown under an artificial shade of cloth.

CIGAR WRAPPER AND BINDER TYPES.

The Connecticut Valley and the area centering around Gadsden County, Fla., and Decatur County, Ga., are the principal wrapper-leaf sections, while Wisconsin is typically a binder-producing State. The Big Flats district of New York and Pennsylvania also produces mainly a binder leaf. The typical wrapper-leaf soils of the Connecticut Valley and Florida are fine sands and sandy loams containing only a very small percentage of clay and having a very limited capacity for holding water. The subsoils are variable in composition, but as a rule contain at most only moderate amounts of clay. The binder-leaf soils of Wisconsin are sandy loams, light clay loams, and the prairie soils, which are a dark, rich loam.

Connecticut Havana Seed.

PREPARATION AND CARE OF THE SEED BED.

The young plant is developed from the seed in a cold frame or hotbed until it has reached a convenient size for transplanting. A convenient width for the seed bed is 6 feet, and it should be of sufficient length to give the required area, 180 square feet being sufficient to produce plants for 1 acre. In the districts farthest north hotbeds may be used in order to secure quick growth; otherwise, the better practice is to use a cold frame with a southerly exposure. The best seed-bed soil is a loose loam of high fertility and thoroughly drained. In the fall 40 pounds of lime and 200 pounds of stable manure to 100 square feet of bed area are plowed under. In the spring, about two weeks before sowing the seed, additional fertilizers should be applied, consisting of 20 pounds of cottonseed meal or castor pomace, 1 pound of acid phosphate, and one-half pound of carbonate or sulphate of potash per 100 square feet of bed area. These materials are thoroughly spaded into the soil to a depth of 4 or 5 inches, and the bed surface is brought to a fine tilth. If the facilities are available, the soil should be sterilized with steam to reduce to the minimum fungous diseases and the growth of weed seeds.[1]

The best time for sowing the beds is from the middle of March to the middle of April. It is seldom safe to set the plants in the field before the middle of May or the first of June, on account of the danger of late frosts and cold nights. In cold frames from 6 to 8 weeks are required to produce plants of suitable size for transplanting to the field, and in hotbeds 4 to 6 weeks are required. If cloth instead of glass is used to cover the seed beds, 8 to 10 weeks are necessary to develop the plants to the proper size for transplanting.

The rate of sowing seed is important, for if the seeds are sown too thickly the plants will be delicate and spindling, while very thin seeding will produce short, thick-set plants, poorly suited for transplanting. The better practice is to sow at the rate of an even teaspoonful of dry seed to 100 square feet of bed area. In order to secure an even distribution of the seed it is thoroughly mixed into 2 quarts of land plaster, finely sifted wood ashes, or bone meal. Three sowings should be made in order to insure an even distribution over the bed, the light color of the filler material serving to indicate the evenness of the distribution. The seed must be covered very lightly, and it will be sufficient to go over the bed with a roller or to pack the soil with a plank. After sowing, the beds are covered with glass or with cheesecloth.

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[1] See Farmers' Bulletin 451 for details regarding the steam sterilization of seed beds.

The seed beds require careful attention, more especially those covered with glass. The beds should be maintained in a moist but not wet condition, and never should be allowed to dry. Sufficient ventilation must be given, and the temperature within the beds must not be allowed to become too high, as the plants are very liable to "burn." With glass-covered beds a cheesecloth or light canvas laid over the glass will be found an efficient aid in preventing burning, and during the night the cloth will also check radiation and tend to maintain a warmer temperature within the bed.

When the plants have developed from four to six leaves and are 5 to 6 inches in height, they are ready for transplanting. During the week prior to transplanting, the plants should be "hardened" by removing the cover from the beds during the greater part of the day, increasing the period each day until finally, if the weather is at all favorable, the covers should be left off entirely.

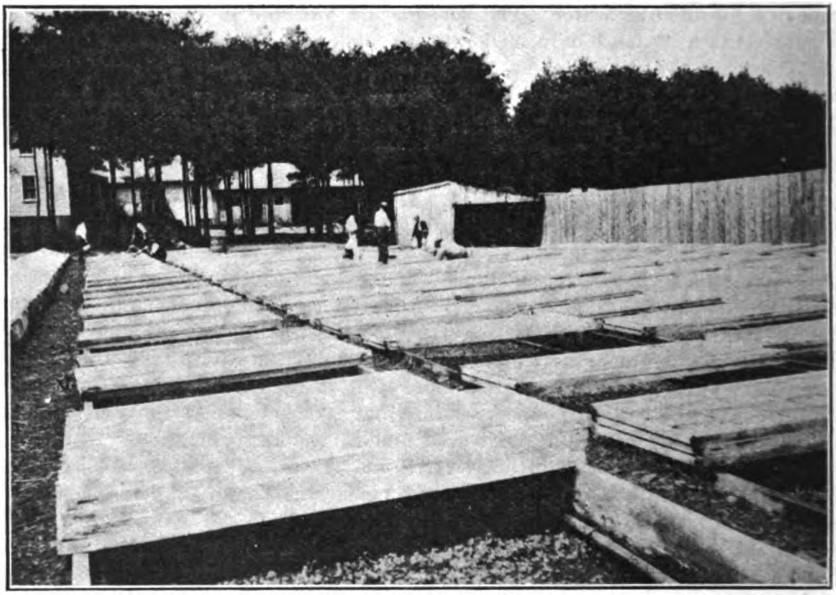

FIG. 1.—Tobacco seed beds with glass covers partly removed, showing the small seedlings.

Before pulling the plants from the beds the soil should be thoroughly wetted to avoid the unnecessary breaking of the roots. The plants should be pulled from the bed separately and put into baskets or small boxes, in which they are carried to the field. They should be kept cool and in a moist condition, especially at the roots. No plant that has wilted should be transplanted. Seed beds covered with glass are shown in figure 1.

PREPARING AND FERTILIZING THE LAND.

A rapid and uninterrupted growth is necessary to secure the finest textured leaf, and clean and thorough cultivation are essential. Care is required in the preparation of the soil, and it should be brought to a fine tilth. Special attention must be given to the matter of fertilizing the crop, and the use of fertilizers containing chlorin is to be avoided, as this element tends to injure the burning qualities of the leaf.

In the preparation of the field 10 to 20 tons of stable manure are plowed under, preferably in the fall. In the spring the land is again plowed and harrowed. The fertilizers are then broadcasted, this being done with a machine adapted to the purpose.

When manure has been used an application of fertilizer should be made, consisting of 1 ton per acre of a high-grade mixture, analyzing about 5 per cent nitrogen, 5 per cent phosphoric acid, and 6 per cent potash, using cottonseed meal, castor pomace, or fish as the source of nitrogen, precipitated bone or a superphosphate to furnish the phosphoric acid, and high-grade sulphate or carbonate of potash, wood ashes, or vegetable potash to supply the potash. When no manure is applied the proportion of nitrogen should be increased so that the analysis of the mixture is about 6 per cent nitrogen, 5 per cent phosphoric acid, and 6 per cent potash. The chief value of the manure, however, is in its beneficial effect upon the physical character of the soil, thereby producing a better textured leaf. Tobacco stems secured from cigar and tobacco factories may also be used, mainly as a substitute for stable manure. Though they are to be regarded as a source of humus, the stems contain larger quantities of plant food than manure and therefore should be applied in smaller quantities. Two tons per acre of "seed" stems (stems from cigar factories) or 2½ tons of "Kentucky" stems (secured from the tobacco factories) are considered to give good results.

Lime also should be added to the soil. On land which has not received lime for several years an application of 1,500 to 2,000 pounds per acre of high-grade burned lime, or the equivalent of ground limestone, is desirable. After the first application, annual applications of 500 to 800 pounds per acre should be made. The lime is broadcasted separately and just before the other fertilizers are put on. The value of the lime is not limited to its effect upon soil conditions and plant growth, as it tends to improve the burning qualities of the finished leaf.

Immediately before transplanting, the field should again be harrowed until all clods are broken. A smoothing harrow and plank should then be drawn over the field, after which the rows are marked off. If a transplanting machine is used, the marking off of the rows is unnecessary, as a marker on the machine can be used to gauge the position of each succeeding row.

TRANSPLANTING AND CULTIVATING.

The plants should be set in rows 3 feet 3 inches to 3 feet 6 inches apart. In the rows the plants may be set from 14 to 20 inches apart, the best distance for average conditions being about 17 inches. The setting of the small plant requires care in order that the roots may be given an opportunity for rapid development, so that the plants may grow off promptly. Where a transplanting machine is used the distance of setting, the application of water, and the firm establishment of the plant are automatically regulated; but when the crop is small, say an acre or less, a machine can not profitably be employed. The type of machine most used in transplanting is shown in figure 2.

In hand setting, the method is as follows: After the rows have been marked on the field, the points at which the plants are to be set may be marked out by running along the row a light buggy wheel, with projections set on its rim at the proper intervals, or by the use of other simple devices. A hole 4 to 6 inches in depth is then made with a dibble to receive the plant. Unless the soil is already thoroughly wet, the holes are filled with water. The soil quickly puddles after the water has been applied, and the plant should be set immediately. The roots should be placed in the puddled mass and before all of the water has been absorbed by the soil. The surrounding soil is then drawn about the roots and stalk of the plant and firmly pressed, so that the plant is maintained in an erect position, allowing the bud to remain just above the surface.

If possible, transplanting should be done on a cloudy or rainy day or in the afternoon, so as to avoid excessive wilting. It requires several days for the plants to recover from the shock due to transplanting, but as soon as practicable all plants which have died should be replaced by healthy ones freshly drawn from the seed bed. The field should be gone over at least three times within the first two weeks, for it is important to obtain as nearly a perfect stand as possible. Damage from cutworms must be guarded against, and if they are present constant resetting during the first three weeks may be necessary.[1]

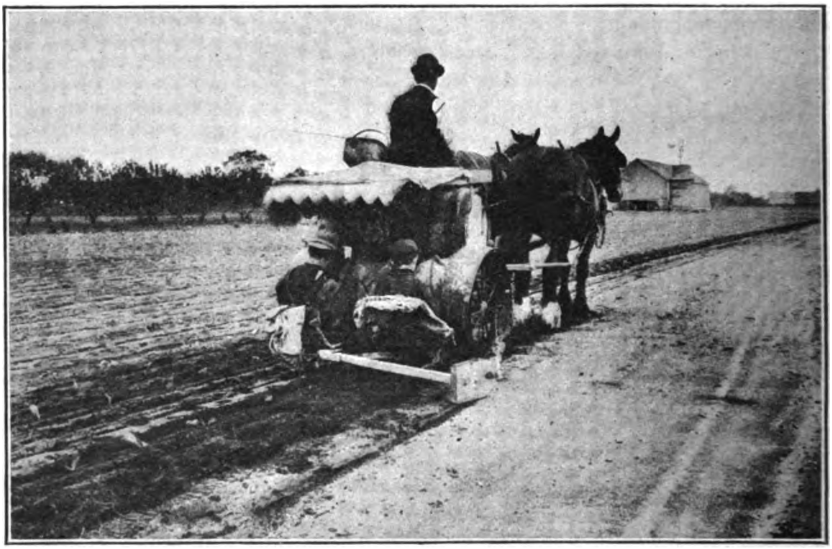

FIG. 2.—Transplanting tobacco with a horse machine.

After the field has been set about a week, cultivation should begin and should be maintained as long as the size of the plants permits. Ordinary surface cultivation to maintain a loose, fine mulch about the plant, with frequent hoeing to keep down weeds, is essential. Cultivation should be shallow, especially in the later stages of growth, to avoid injury to the roots of the plant.

When about one-half of the plants in the field have developed seed heads, but before these have bloomed, "topping" should be done. This consists of breaking off the top or crown of the plant at about the third sucker or branch below the seed head, so as to allow the plant to develop more fully the lower leaves. After topping, suckers or lateral branches will soon develop in the axils of the leaves, and these should be removed by hand before they become large enough to retard the development of the leaves. In topping and suckering, the field must be gone over two or three times, the aim being to cause all of the plants in the field to mature at about the same time, and hence those plants developing a seed head later than the average should be topped lower.

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[1] For methods of combating cutworms, see Farmers' Bulletin 120.

HARVESTING.

Either of two methods of harvesting Havana Seed tobacco may be used. The one most commonly practiced is to cut the whole plant when the middle leaves are "ripe," i. e., when the leaves have assumed a lighter shade of green and have thickened so that upon folding a section of the leaf it creases or cracks on the line of folding. In harvesting the plants, the stalk is cut near the ground with a light hatchet, knife, saw, or a special form of long-handled shears, and the plant is carefully laid upon the ground, where it is allowed to remain until the leaves have wilted sufficiently to avoid much breaking in handling. It is then hung upon a lath 4 feet long by piercing the stalk near its base with a removable metal "spearhead" placed on the end of the lath and sliding the stalk on the lath. As a rule, six plants should be hung on a lath and distributed evenly. Instead of spearing the stalk it may be hung upon the lath by means of a hook or a nail driven through the lath at a sufficient angle to hold the plant securely. Six hooks or nails are put at equal distances on the lath, the three on one side alternating with those on the opposite side. The method of harvesting by cutting and spearing the stalk on the lath is shown in figure 3.

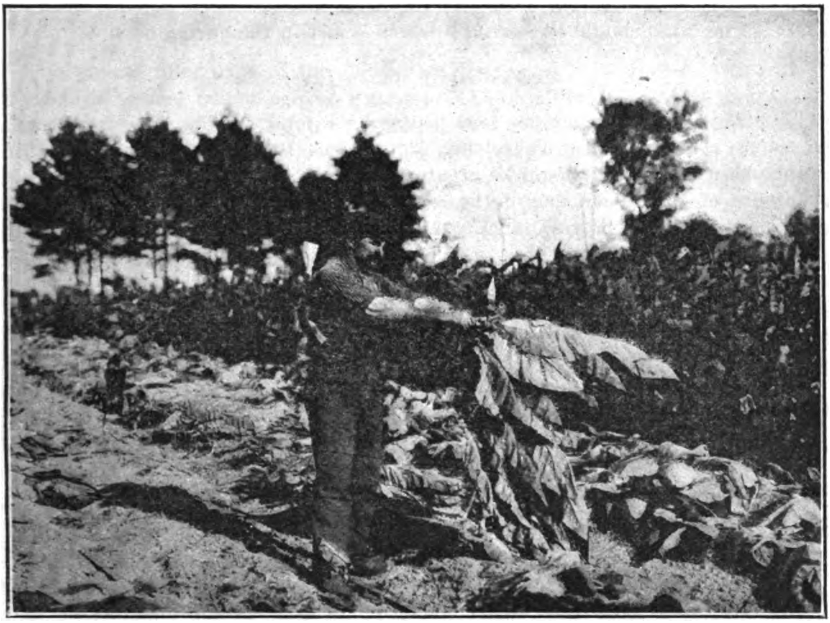

FIG. 3.—Harvesting tobacco by cutting the stalk, showing the method of spearing the plant on the stick.

The laths carrying the plants should be placed upon a rack and hauled to the curing barn, where they are hung in tiers with a space of 6 to 12 inches between the laths.

In the second method of harvesting Havana Seed, the leaves are picked from the plant as they ripen. The degree of ripeness is not so advanced as that described for stalk-cut tobacco. The proper degree of ripeness is very important, for upon this largely depends the development of the desirable qualities of texture, body, color, elasticity, etc., during the process of curing. A safe guide is to take the first picking at the time the seed head forms, and subsequent pickings at intervals of six days. Five pickings should be made, the first one comprising the lower four leaves of commercial size and, proceeding upward on the plant, the second and third pickings each including three leaves, and the fourth and fifth pickings three or four leaves each. As the leaves are taken from the plant they should be laid in the row and then carried by an attendant in baskets to the curing barn. Here, by means of a large needle, a string is passed through the stem of the leaf near its base, one end of the string being attached to the end of the 4-foot lath, and when the string is full the free end is attached to the other end of the lath. Each lath should carry 36 to 40 leaves, and the leaves should be put on in pairs, so that they are back to back and face to face. The laths should be spaced 5 inches apart in the curing barn.

CONNECTICUT BROADLEAF.

The methods of preparing the seed bed and the land are the same for Broadleaf as for Havana Seed. In setting Connecticut Broadleaf in the field, the distance between plants should be greater than in the case of the Havana Seed, on account of the larger size of the leaf of the former. The best distance of setting the plants in the row is 20 to 24 inches, and the rows should be from 3 feet 3 inches to 4 feet apart, but otherwise the cultural methods to be followed are about the same as for Havana Seed. The same fertilizers are to be used as for Havana Seed, but the quantity applied should be increased by about 20 per cent. The Broadleaf should be harvested by cutting the stalk in the manner described for Havana Seed. However, the first four leaves can be picked and cured separately, and when thus harvested should be taken off about one week prior to cutting the stalk.

COMSTOCK SPANISH.

The Comstock Spanish variety, along with the ordinary Havana Seed, is specially adapted to the production of binder leaf in Wisconsin. The seed beds should generally be sown during the latter half of April. Barnyard manure is used with good success in fertilizing the tobacco soils, but thus far commercial fertilizers have been used more sparingly than in the Connecticut Valley. Transplanting from the seed bed to the field under normal conditions should be done during the month of June, more commonly during the latter half of the month. The rows should be 34 to 38 inches apart and the plants should be set 18 to 20 inches apart in the row. The tobacco should be topped somewhat lower than in Connecticut. Harvesting, which is done by cutting the stalk in the manner described for Havana Seed, should begin about three weeks after topping.

CUBAN.

Acclimated strains of Cuban seed are grown under artificial shade in the Florida-Georgia district and in the Connecticut Valley for the production of a high-priced cigar-wrapper leaf. This phase of the industry, however, is very intensive and highly specialized, requiring the greatest skill and expert knowledge, and is largely carried on by corporations or individuals having ample capital. Cuban tobacco is also grown under ordinary conditions for cigar-wrapper purposes in the southern districts, but it is preeminently a filler variety and will be discussed more fully as such.

CIGAR-FILLER LEAF.

Our domestic cigar-filler leaf is produced mainly in the Lancaster (Pa.), the Miami Valley (Ohio), and the Onondaga (N. Y.) districts, and in restricted areas of Florida, Georgia, and Texas. The best filler-leaf soils, mostly loams, are decidedly stronger than those adapted to wrapper leaf, containing more clay and retaining larger percentages of water. In the main, these soils are well adapted to general farming, and the tobacco is, or should be, grown in rotation with other crops. Cultural methods differ principally from those followed in the wrapper districts, in that the plants are spaced farther apart in the field and are topped lower so as to obtain a heavier leaf, and the tobacco is allowed to become riper before it is harvested. In general, less intensive methods are followed than in the wrapper districts, since filler leaf commands only moderate prices.

PENNSYLVANIA BROADLEAF.

The typical filler soils of the Lancaster district are the Hagerstown and the Conestoga loams, which are of limestone origin. The method of preparation and the care of the seed bed are essentially the same as in the wrapper districts. The seed usually should be sown during the first half of April, and transplanting, which is generally done with a horse transplanter, should take place through the month of June. The soil needs to be put into good condition by plowing and harrowing. Stable manure should be used liberally, usually at the rate of 10 loads or more per acre. Commercial fertilizers thus far have not been used so extensively as in Connecticut. The rows should be 3 to 3½ feet apart, and the plants should be set 24 to 30 inches apart in the row. The better practice is to top the plants before the flower head begins to bloom, and a smaller number of leaves should be left than in the case of wrapper types. The suckers must be promptly removed as they develop. The tobacco must be allowed to become full ripe, as judged by the signs indicated for the wrapper type, and should be harvested by cutting the stalk at its base and spearing it on laths, as described for Connecticut Havana Seed.

ZIMMER SPANISH.

The Zimmer Spanish variety is grown principally in the Miami Valley of Ohio. The principal soil types have been designated as "Miami clay loam," and "Miami black clay loam." The Zimmer Spanish, so called, seems to be practically identical with Havana Seed, as has already been stated. The seed beds are best sown during the latter part of March and through April. Transplanting should be done during the first three weeks of June. Commercial fertilizers should be used freely, and good results are obtained in applying as much as 1,000 pounds per acre of a mixture analyzing about 4 per cent nitrogen, 9 per cent phosphoric acid, and 8 per cent potash—that is, one supplying about 40 pounds of nitrogen, 90 pounds of phosphoric acid, and 80 pounds of potash. Barnyard manure also gives good results. The rows should be placed 34 to 38 inches apart and the plants set 28 to 32 inches apart in the row. The plants should be topped before blooming and should be kept free of suckers. The time and method of harvesting are about the same as for Pennsylvania Broadleaf.

CUBAN.

The Cuban variety is grown mainly for filler leaf in the southern cigar-tobacco districts. The best results are obtained on soils somewhat heavier than the types best adapted to wrapper leaf. The seed bed is burned to destroy weed seeds, as is described for the export and manufacturing types. The seed may be sown in January or February. Fertilizers are to be applied to the bed, as has been described for the cigar-wrapper type, except that potash may be omitted from the fertilizer mixture. The beds must be sprayed with Paris green or with arsenate of lead to control insects. The seedlings are ready for transplanting when they are 4 to 5 inches high. The tobacco land should be plowed in the fall and must be liberally fertilized. When 15 or 20 loads of manure per acre are applied, a mixture of 600 or 800 pounds of cottonseed meal, 400 pounds of acid phosphate, and 200 pounds of sulphate of potash usually gives good results. The rows are made 3 to 3½ feet apart and the plants are set 14 inches apart in the row. The plants should be topped to 12 to 16 leaves and the suckers are removed as often as they appear. The tobacco should be harvested just before it becomes fully ripe. For filler leaf the proper method of harvesting is by cutting the stalk, but when there is promise of obtaining a considerable percentage of wrapper leaf the harvesting is done by picking the leaves as they ripen, in the manner described for Connecticut Havana Seed. The details of harvesting by cutting the stalk are essentially the same as for the northern wrapper varieties.

THE CULTURE OF THE EXPORT AND MANUFACTURING TYPES.

EXPORT AND MANUFACTURING TOBACCO VARIETIES.

White Burley is a distinctive variety, producing a type of cured leaf known by the same name, practically all of which is used in domestic manufacture. This variety, of which there are several subvarieties, such as the Stand-Up and Twist Bud, is grown mainly in north-central Kentucky, southern Ohio, southwestern West Virginia, and southeastern Indiana. Aside from its peculiar chlorotic appearance, Burley more closely resembles the cigar-seedleaf group than the other export and manufacturing varieties (except the Maryland).

The Maryland is another fairly distinctive variety, in many respects resembling the cigar-seedleaf and White Burley varieties. The type of leaf produced is known as Maryland tobacco. Two subvarieties of the Maryland are known as Broadleaf and Narrowleaf, respectively.

In the production of the remaining types of export and manufacturing tobaccos, such as the flue cured and fire cured, a very large number of so-called varieties are used more or less interchangeably. Nearly all of these may be regarded as coming under two principal groups, namely, Oronoco and Pryor, although in many cases the distinctions between the strains or subvarieties are so slight as to make it impossible to determine in which of the two groups each really belongs. Of the Oronoco group may be mentioned the Big Oronoco, Little or Narrow-Leaf Oronoco, White-Stem Oronoco, Lizard Tail, Gooch, and Flanagan. Among the group of Pryors there are the Blue Pryor, Yellow Pryor, White or Medley Pryor, and Silky Pryor. Two additional varieties or subvarieties of the export and manufacturing tobaccos of importance are the Yellow Mammoth and One Sucker.

FIRE-CURED EXPORT TOBACCO.

The fire-cured export type of tobacco is grown almost exclusively in western Kentucky and Tennessee and in central Virginia. Its principal characteristics are its dark color, heavy body, and a distinctive flavor imparted to it from the smoke of the open fires used in curing. By far the greater portion of this type is exported. The soils producing the fire-cured export leaf are heavy, containing a high percentage of clay or silt, and hence would not be adapted to the culture of most other types of tobacco. The principal varieties used in producing the fire-cured tobacco are the Pryors, the Yellow Mammoth, and the Oronocos.

THE SEED BED.

A well-drained, friable soil having a southern or eastern exposure is to be preferred for the seed bed, and when practicable a suitable spot in the woods is chosen. Selecting a time, after removing the forest growth, when the soil is not too wet, it is burned to destroy weed seeds and insects. A good method is to lay small poles or skids over the area to be burned, at intervals of 3 feet, and to pile brush and wood on one end of the skids. After setting fire to the brush the burning material is pulled forward on the skids as rapidly as the soil becomes sufficiently heated and sterilized to a depth of 2 or 3 inches. After removing all débris, the soil is thoroughly spaded or plowed to a depth of a few inches. Before seeding, a fertilizer consisting of about 5 pounds of cottonseed meal or 2 or 3 pounds of nitrate of soda and 1 pound of acid phosphate for each 100 square feet of bed is to be worked into the soil. In sowing, the seed should be mixed with a large volume of fertilizer, corn meal, or sifted ashes (about 2 quarts for each teaspoonful of seed), in order to secure an even distribution of the seed. A heaping teaspoonful of seed is sufficient to sow 25 square yards of seed bed and should furnish enough plants to set an acre in the field. The seed beds may be sown in January, February, or March. The seed must be covered only very lightly, and it is better simply to press the soil down firmly by trampling or with a board or roller. The bed should be surrounded with logs or boards set on edge to a height of 6 to 10 inches to form a cold frame, over which are stretched wires to support the cheesecloth which is to be placed over the frame before the plants come up. The precautions regarding watering and hardening the plants prior to transplanting, as described for the cigar types, are to be carefully followed.

TRANSPLANTING AND CULTIVATING.

Prior to transplanting, the land should be thoroughly fitted by plowing and harrowing, after which the rows are laid off, the preferred distance between rows being 3½ feet. In Kentucky and Tennessee the plants are usually set in checks; that is, they are set 3½ feet apart each way, while in Virginia they are generally spaced 2½ to 3 feet apart in the row. The accurate spacing of the plants may be readily attained by using a simple marking device, which is drawn across the field so as to indicate the points at which the plants are to be set. Throwing up slight ridges for the rows will remove the danger of the young plants being drowned in case of heavy rains. Transplanting is done mostly by hand and in much the same way as has been described for the cigar tobaccos. Fertilizers should be applied in the process of preparing the land for transplanting. But little barnyard manure is available in the fire-cured districts, and commercial fertilizers are generally used rather sparingly, the usual application being 200 to 400 pounds per acre of a mixture containing about 3 per cent nitrogen, 8 per cent phosphoric acid, and 3 per cent potash. Much larger quantities of fertilizer will give better results in most cases. A clover sod plowed under in the fall gives good results with this type of tobacco.

Cultivation should begin as soon as the plants start to grow and should continue as long as the size of the plants will permit. The first cultivation is deep, after which frequent shallow cultivations are most desirable. Where the plants are set in checks they may be cultivated both ways, so as to reduce the amount of hand hoeing required to keep down weeds.

TOPPING AND SUCKERING.

When 10 to 15 leaves have appeared on the plant the top should be broken out, so as to force all of the growth into the leaves left on the plant and cause them to grow larger, thicker, and darker. A favorite practice is to pick off and discard 3 or 4 of the bottom leaves, and then top the plants so as to leave 8 to 12 leaves on each plant. High topping tends to delay maturity and to produce a thinner leaf. The aim in topping is to leave only as many leaves on the plant as it can bring to the fullest development and as far as possible to insure that all plants will mature at about the same time. The suckers which develop in the axils of the leaves must be removed as rapidly as they appear.

HARVESTING.

The plants generally are ready for harvesting in from 30 to 40 days after topping. At this stage the leaves will have taken on a lighter color and become thick and heavy, and small yellow flecks will have appeared, especially near the edges of the leaf. It is not desirable to harvest the tobacco for two or three days after a heavy rain, as the gum which accumulates on the leaf in dry weather and improves its quality is washed off by the rain. In harvesting, the stalk should first be split with a knife from the top down to within a few inches of the bottom, in such a way as not to cut or injure the leaves. The stalk is then cut off near the ground and laid on the ground to wilt sufficiently to permit handling without breaking the leaves. The plants should then be placed astride sticks and hauled to the curing barn. In Virginia the plants are usually placed on the sticks before being laid on the ground to wilt. The sticks are 4 feet 4 inches long, and five to eight plants, depending on tneir size, should be placed on each stick. The sticks carrying the plants should be arranged on the tier poles of the curing barn at intervals of 6 to 8 inches.

WHITE BURLEY TOBACCO.

White Burley tobacco reaches its highest state of development on the limestone soils in the famous bluegrass section of Kentucky and in southern Ohio. This variety is light in color and body and possesses an exceptionally large absorptive capacity for the liquid flavoring materials used in the manufacture of plug tobacco.

The methods of preparing, sowing, and caring for the seed beds are about the same as described for the fire-cured export tobacco. Burley tobacco gives the best results when grown on virgin soil or on a bluegrass sod which has been standing for at least six or eight years. Under these conditions two or three excellent crops of tobacco can be obtained, after which the results are unsatisfactory until the land has again stood in bluegrass for several years. In preparing the land, a bluegrass sod should be turned under in the fall and thoroughly cultivated with a disk harrow in the spring. On a heavy bluegrass sod, manure or fertilizers are seldom required for the tobacco.

Burley tobacco plants should be set 18 to 24 inches apart in the row, with the rows 3½ feet apart. Transplanting by machine has proved very satisfactory. Cultivation should be shallow, frequent, and thorough. The tobacco must be topped comparatively high, from 14 to 18 leaves being left on the plant. Careful attention must be given to the removal of the suckers. The crop should be harvested in the same manner as the fire-cured export tobacco, except that when cut it is preferred that the plants be immediately placed astride the stick, one end of which is forced into the ground at an angle in such a position that the stick bearing the plants rests on the stubble of a severed plant. The tobacco is to be left in this position till wilted and then carried to the curing barn. The sticks bearing the plants should be placed 8 to 10 inches apart on the tier poles.

FLUE-CURED TOBACCO.

The flue-cured type of tobacco, frequently spoken of as yellow tobacco, is grown extensively in the eastern counties of South Carolina, in the northern and eastern counties of North Carolina, and in southern Virginia. It is used largely in the manufacture of cigarettes, smoking and plug tobacco, and for export. The bright color of the leaf is due mainly to the character of the soil upon which it is grown and to the method of curing. The typical soils are light sands and sandy loams with yellow or red subsoils containing a small proportion of clay. The varieties most used in growing flue-cured tobacco are strains or subvarieties of the Oronoco and the Pryor groups, such as Little Oronoco, Big Oronoco, Warne, Gooch, Adcock, Yellow Pryor, and Flanagan.

The methods of preparing and caring for the seed beds and fitting the land are essentially the same as for the fire-cured export tobacco. The rows should be laid off 3½ or 4 feet apart and the plants set 24 to 36 inches apart in the row. Transplanting should begin about the first of April in South Carolina and extend into May or even June in the western portions of the North Carolina district. The bright-yellow color of this type is one of its most valued characteristics, and for this reason large quantities of nitrogenous fertilizers must be avoided. The soils producing the best quality of leaf are naturally infertile, and commercial fertilizers are freely used with profit, but the proportion of nitrogen in the fertilizers must be kept comparatively low. For an acre of the average flue-cured tobacco soil it is recommended that a mixture be used consisting of 250 pounds of dried blood containing 16 per cent of ammonia (13 per cent nitrogen), 500 pounds of acid phosphate containing 16 per cent phosphoric acid, and 120 pounds of sulphate of potash containing 50 per cent of potash. Cottonseed meal also gives good results as a source of ammonia. For a more fertile soil the quantity of fertilizer above recommended should be reduced somewhat, especially as regards ammonia. The methods of cultivation, topping, and suckering are about the same as for fire-cured tobacco.

Flue-cured tobacco should be thoroughly ripe when harvested. The leaf surface should show numerous patches of a light-yellow color, and even the green portions should be of a light tint; otherwise, it will be difficult or impossible to cure the leaf properly. In the eastern portion of the flue-cured districts the preferred method of harvesting is to pick off the leaves as they ripen, beginning at the bottom of the plant and taking two or three leaves at each picking. The leaves should be taken to the barn and attached in small bunches to the sticks by means of strings. The string is attached to an end of the stick and near this end is passed once around the stems of three to five leaves, thus forming a small bunch which will hang to one side of the stick. The string is then drawn diagonally to the opposite side of the stick and similarly looped around a second bunch of leaves and the process repeated until the stick is full, when the free end of the string is attached to the other end of the stick. In the western portion of the flue-cured district the preferred method is to harvest the tobacco by splitting the stalk, cutting it off at the base, and placing it astride the stick, as in the case of fire-cured and Burley tobacco. The field must be gone over from two to four times in order to get all of the plants at the right stage of ripeness.

DARK MANUFACTURING TOBACCOS.

In the portion of Kentucky and Tennessee lying between the Burley district and the dark fire-cured sections, types of tobacco are produced in large quantities suitable for domestic manufacture into chewing and smoking tobacco. These types are mostly air-cured, like Burley, but in other respects the methods of production are quite similar to those followed for the dark fire-cured tobacco. In the southern portion of this territory, centering around Warren County, Ky., the so-called One Sucker is the principal variety grown.

In a few counties of Virginia in the vicinity of Richmond, a type of leaf long known as Virginia Sun-Cured is produced. Formerly the tobacco was exposed to the sun in the process of curing (hence the name), but at the present time air curing as practiced in the Burley district is the more common method. This type is specially adapted to the manufacture of chewing tobacco. Aside from the curing and somewhat higher topping, substantially the same methods of production should be followed as have been outlined for the fire-cured export tobacco.

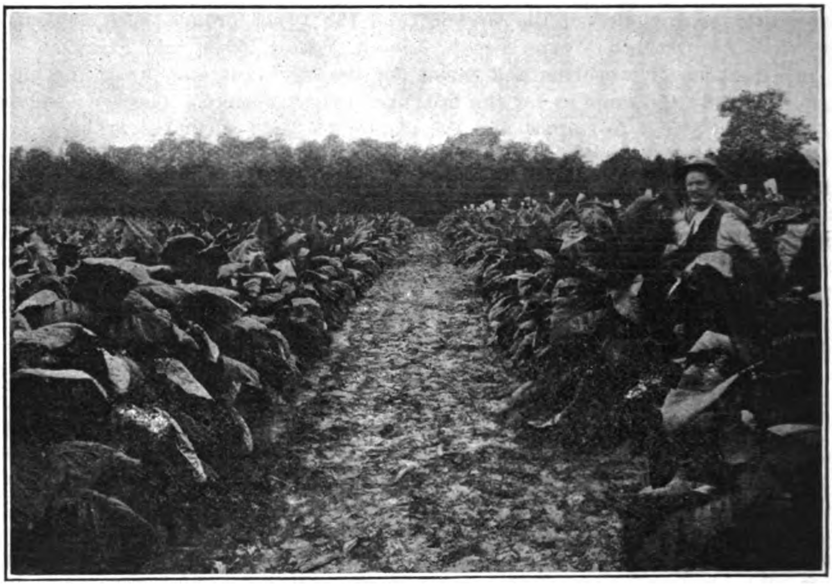

FIG. 4.—Field of tobacco in Maryland which has been topped and is nearly ready for harvesting. On the right are shown seed heads of selected plants covered with bags to prevent crossing.

MARYLAND TOBACCO.

The Maryland type is produced extensively in the section lying between the Potomac River and Chesapeake Bay known as southern Maryland. This tobacco is light in body and color, of a dry or chaffy character, and has good burning qualities. It is an export type, and goes mostly to France, the Netherlands, and Germany.

The tobacco soils of Maryland are sandy or silty in character, the soil and subsoil being gray or yellow in color, and are usually deficient in humus. When available, stable manure gives good results. Low-grade fertilizers are quite generally used, but only in small quantities. The tobacco may be conveniently set in squares, the plants being 32 to 36 inches apart each way. Cultural methods are about the same as for other types. The plants are topped at 16 to 20 or more leaves, depending on the vigor of the plants and the seasonal conditions. The tobacco matures in two to four weeks after topping, and should be harvested by cutting the stalk and spearing on a stick, as described for the cigar-leaf types. A field of Maryland tobacco nearly ready for harvesting is shown in figure 4.

INSECT ENEMIES OF TOBACCO.

One of the most troublesome and expensive features of tobacco culture, particularly in the southern districts, is the control of numerous insects, which if not combated would oftentimes completely destroy the commercial value of the crop. Among the more important insects attacking the tobacco plant may be mentioned the tobacco flea-bettle, the tobacco "wireworm," cutworms, the hornworms, or "green worms," and the tobacco budworm. Of these the hornworms, or "green worms," are usually the most destructive.

For detailed information regarding insects attacking tobacco and methods of combating them, the reader is referred to Farmers' Bulletin 120, entitled "The Principal Insects Affecting the Tobacco Plant."

A1.
No. 5

U. S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN No. 571

TOBACCO CULTURE

TOBACCO LEAF when cured is classified as cigar tobacco, export tobacco, or manufacturing tobacco, and each class is divided further into types, according to characteristics and appropriate use.

Differences in soil and climate have great influence upon the quality of tobacco leaf, and particular types, therefore, are grown chiefly in certain well-defined areas. New types are not in demand, and efforts to introduce tobacco culture in new sections are not likely to succeed.

This bulletin indicates the areas in which the different types are produced. It gives the necessary details regarding the varieties of seed to be used and the methods of growing the seedlings, transplanting to the field, fertilizing, cultivating, caring for, and harvesting the crop in each of the more important tobacco-growing regions.

Washington, D. C. **Issued February, 1914; revised November, 1930**

TOBACCO CULTURE

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LOCALIZATION OF TOBACCO PRODUCTION

THE TOBACCO PLANT may be grown successfully in all latitudes from southern Canada to the Tropics and on a great variety of soils, but the commercial value of the product is influenced to a greater degree by the particular soil and climatic conditions under which the plant is grown than is almost any other important crop. These facts are so well recognized that the tobacco industry has become highly specialized, and the trade regularly looks to certain well-defined areas of production for its supply of the various classes and types of leaf required. In these tobacco-producing districts the necessary facilities for marketing are available, and prevailing prices of the cured leaf are governed largely by the relative supply and demand and by the quality of the leaf produced.

Each important district produces a tobacco of certain well-known characteristics which make it desirable for special purposes of manufacture or export. Moreover, in practically all of these districts the production can be readily increased to meet any increased demand at profitable prices. For these reasons efforts to introduce the commercial growing of tobacco in sections outside of the established producing centers are likely to result in failure, either because the leaf produced is not quite right in type or satisfactory marketing facilities are not available. Furthermore, any development of the industry in a new section on a large scale, which would be essential for economical marketing, would most likely lead to overproduction and, as a consequence, unprofitable prices. As a matter of fact, overproduction is a constant menace in all of the established centers of tobacco growing.

The methods of growing and handling the crop must be varied according to the type of leaf which it is desired to produce, for the kind of tobacco obtained is influenced very greatly by the methods of growing and handling which are employed. The methods for the production of the various types briefly outlined in the present bulletin, though possibly susceptible of improvement in some of the details, are the best that can be recommended in view of the present knowledge and experience of investigators and the more successful growers.

CLASSES AND TYPES OF TOBACCO

As is well known, tobacco is manufactured into various forms for consumption, but large quantities also are exported in an unmanufactured state, so that we may distinguish three general classes of tobacco, i. e., (1) cigar tobaccos, (2) export tobaccos, and (3) manufacturing tobaccos. By manufacturing tobaccos are meant all types used in manufactures other than cigars. The manufacturing and export classes, however, have much in common as regards cultural methods, and some types are used both for manufacturing and for export; therefore these two classes will be considered together as distinguished from the cigar tobaccos.

Each of these three classes of tobacco may be subdivided into types, depending on their special uses, methods of growing and curing, or on the variety of seed used. In the case of cigar tobaccos there are three principal types, corresponding to the three parts of the cigar—wrapper leaf, binder leaf, and filler leaf. In the manufacturing and export tobaccos are such types as the flue-cured, Virginia sun-cured, White Burley, dark fire-cured, one sucker, Green River, and Maryland. These various types are produced on certain special types of soil and according to definite methods of growing, curing, and handling the crop. In some cases the variety of seed used is also an important factor. The special uses of the principal types embraced in the three fundamental classes of tobacco are brought out in connection with the cultural directions for the more important types.

THE CULTURE OF CIGAR TOBACCOS

While cultural methods in their application to the different cigar-tobacco types and districts may be modified to advantage in some of the details, the essential features are more or less similar, so that it will suffice to outline the most approved methods for the Connecticut Valley, and only the more important differences in cultural methods to be followed in the remaining districts need be mentioned.

CIGAR-LEAF TOBACCO VARIETIES

There are three principal varieties or groups of varieties used in growing cigar tobaccos in this country, i. e., the Broadleaf or Seedleaf group, the Havana Seed group, and the Cuban group. The typical Broadleaf or Seedleaf is the Connecticut Broadleaf, extensively grown in the Connecticut Valley for binders and wrappers. Acclimated strains of this variety have been developed and are grown in all the northern cigar-leaf States for the production of binder and filler leaf, and in each case these strains are given the name of the State in which they are grown. Thus, we have the Pennsylvania Broadleaf, or Seedleaf; the Ohio Broadleaf, or Seedleaf, etc.

The Connecticut Havana, or Havana Seed, also is extensively grown in the Connecticut Valley for wrapper and binder leaf purposes, and in other northern cigar-tobacco districts for binder leaf, and to some extent for filler leaf. The name "Havana Seed" usually is applied to this variety as grown in any of the northern cigar-tobacco districts, but it is preferable in each case to prefix the name of the State in which it is grown, as is done with the Broadleaf group. There is an important group of so-called Spanish varieties, extensively grown for binder and filler leaf purposes, which are very closely related to or identical with the Havana Seed. The two most important members of this group are Zimmer Spanish, principally grown for filler in the Miami Valley of Ohio, and the Comstock Spanish, chiefly grown for binder leaf in Wisconsin. Zimmer Spanish, as grown in Ohio is markedly different in quality from Connecticut Havana as grown in New England, but when the two are grown side by side it is practically impossible to distinguish the one from the other.

Another variety of some local importance in the Miami Valley of Ohio is known as "Little Dutch," of which there are several strains. This variety, which relatively is narrow leaved, is thought to have been introduced from Germany.

The Cuban group is composed of strains or selections obtained from imported seed. Seed imported from Cuba is usually found to be composed of several distinct subvarieties. The Big Cuban is the most important variety in the southern cigar-tobacco districts, although Connecticut Round Tip and Sumatra are grown to some extent for wrapper and filler, respectively. In the Connecticut Valley a considerable acreage of Cuban tobacco for the production of wrapper leaf is grown under an artificial shade of cloth.

CIGAR WRAPPER AND BINDER TYPES

The Connecticut Valley and the area centering around Gadsden County, Fla., and Decatur County, Ga., are the principal wrapper-leaf sections, while Wisconsin is typically a binder-producing State. The Big Flats district of New York and Pennsylvania also produces mainly a binder leaf. The wrapper-leaf soils of the Connecticut Valley and Florida are of the sandy and sandy-loam types, containing only a very small percentage of clay and having a very limited capacity for holding water. The subsoils are chiefly sandy or sandy loam in character, containing at most only moderate amounts of clay. The binder-leaf soils of Wisconsin are sandy loams, light clay loams, and the prairie soils, which are dark, rich loams.

CONNECTICUT HAVANA SEED

PREPARATION AND CARE OF THE SEED BED

The young plant is developed from the seed in a coldframe until it has reached a convenient size for transplanting. A convenient width for the seed bed is 6 feet, and it should be of sufficient length to give the required area, 180 square feet being sufficient to produce plants for 1 acre. The best seed-bed soil is a loose loam of high fertility and thoroughly drained.

In the fall a liberal application of manure is plowed under. In addition, in the fall or prior to planting in the spring, a suitable fertilizer such as a 5-4-5 mixture may be applied at the rate of about 1 pound per square yard of seed bed and worked into the soil. The soil surface is worked to a state of fine tilth. If the facilities are available, the soil should be sterilized with steam to reduce to the minimum fungous diseases and the growth of weed seeds.[1]

The best time for sowing the beds is from the middle of March to the middle of April. It is seldom safe to set the plants in the field before the middle of May or the first of June, on account of the danger of late frosts and cold nights. From 6 to 8 weeks are required to produce plants of suitable size for transplanting to the field. If cloth instead of glass is used to cover the seed beds, 8 to 10 weeks are necessary to develop the plants to the proper size for transplanting.

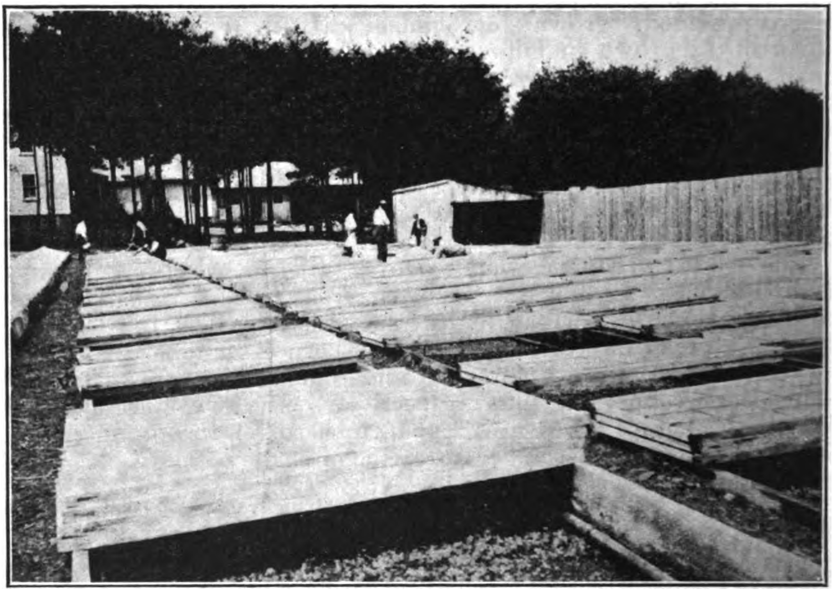

FIGURE 1.—Tobacco seed beds with glass covers partly removed, showing the small seedlings

The rate of sowing seed is important, for if the seeds are sown too thickly the plants will be delicate and spindling, while very thin seeding will produce short, thick-set plants, poorly suited for transplanting. The better practice is to sow at the rate of an even teaspoonful of dry seed to 100 square feet of bed area. In order to obtain an even distribution of the seed it is thoroughly mixed into 2 quarts of land plaster, finely sifted wood ashes, or bone meal. Three sowings should be made in order to insure an even distribution over the bed, the light color of the filler material serving to indicate the evenness of the distribution. The seed must be covered very lightly, and it will be sufficient to go over the bed with a roller or to pack the soil with a plank. After sowing, the beds are covered with glass or with cheesecloth.

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[1] See Farmers' Bulletin 1629 for details regarding the steam sterilization of seed beds.

The seed beds require careful attention, more especially those covered with glass. The beds should be maintained in a moist but not wet condition, and never should be allowed to dry. Sufficient ventilation must be given, and the temperature within the beds must not be allowed to become too high, as the plants are very liable to "burn." With glass-covered beds a cheesecloth or light canvas laid over the glass will be found an efficient aid in preventing burning, and during the night the cloth will also check radiation and tend to maintain a warmer temperature within the bed. It is a common practice to make one or more applications of nitrate of soda in water solution or solid form to the young plants to stimulate their growth, and for this purpose 5 pounds of the soda for each 100 square yards of bed may be used. The fertilizer must be washed from the leaves of the seedlings to prevent burning.

When the plants have developed from 4 to 6 leaves and are 5 to 6 inches in height, they are ready for transplanting. During the week prior to transplanting, the plants should be "hardened" by removing the cover from the beds during the greater part of the day, increasing the period each day until finally, if the weather is at all favorable, the covers should be left off entirely.

Before pulling the plants from the beds the soil should be thoroughly wetted to avoid the unnecessary breaking of the roots. The plants should be pulled from the bed separately and put into baskets or small boxes, in which they are carried to the field. They should be kept cool and in a moist condition, especially at the roots. No plant that has wilted should be transplanted. Seed beds covered with glass are shown in Figure 1.

PREPARING AND FERTILIZING THE LAND

A rapid and uninterrupted growth is necessary to obtain the finest textured leaf, and clean and thorough cultivation is essential. Care is required in the preparation of the soil, and it should be brought to a fine tilth. Special attention must be given to the matter of fertilizing the crop, and the use of fertilizers containing chlorine is to be avoided, as this element tends to injure the burning qualities of the leaf.

In the preparation of the field 10 to 20 tons of stable manure to the acre may be plowed under, preferably in the fall. Manure is not now used so extensively as formerly and when employed at all it is applied as a rule only once in every two or three years. In the spring the land is again plowed and harrowed. The fertilizers are then broadcast, this being done with a machine adapted to the purpose.

An application of fertilizer should be made, furnishing the equivalent of 1 to 2 tons per acre of a high-grade 5–4–5 mixture. As the source of nitrogen a mixture of cottonseed meal, castor pomace, and fish is used, although as much as one-third of the total nitrogen may be derived from nitrate of potash and urea or similar sources. Precipitated bone, superphosphate, and bone meal are suitable sources of phosphoric acid. The potash may be supplied from the carbonate, high-grade sulphate, sulphate of potash-magnesia, vegetable potash, nitrate of potash, or wood ashes. Tobacco stems obtained from cigar and tobacco factories may also be used, mainly as a substitute for stable manure. Though they are to be regarded as a source of humus, the stems contain larger quantities of plant food than manure, and therefore should be applied in smaller quantities. Two tons per acre of "seed" stems (stems from cigar factories) or 2½ tons of "Kentucky" stems (obtained from the tobacco factories) are considered to give good results.

Formerly it was the practice also to apply lime freely to the soil, as it tends to improve the burning qualities of the leaf. Annual applications of 500 to 800 pounds per acre of burned lime or the equivalent of ground limestone have been used commonly. In view of recent work on the subject, however, it appears that the application of alkaline materials to the soil favors the development of certain fungous diseases of tobacco, especially the black root-rot; hence the use of lime is not recommended except where the soil is too acid.

Immediately before transplanting, the field should again be harrowed until all clods are broken. A smoothing harrow and plank should then be drawn over the field, after which the rows are marked off. If a transplanting machine is used, the marking off of the rows is unnecessary, as a marker on the machine can be used to gauge the position of each succeeding row.

TRANSPLANTING AND CULTIVATING

The plants should be set in rows 3 feet 3 inches to 3 feet 6 inches apart. In the rows the plants may be set from 14 to 20 inches apart, the best distance for average conditions being about 18 inches. The setting of the small plant requires care in order that the roots may be given an opportunity for rapid development, so that the plants may start to grow promptly. Where a transplanting machine is used the distance of setting, the application of water, and the firm establishment of the plant are automatically regulated; but when the crop is small, say an acre or less, a machine can not profitably be employed. The type of machine most used in transplanting is shown in Figure 2.

In hand setting, the method is as follows: After the rows have been marked on the field, the points at which the plants are to be set may be marked out by running along the row a light buggy wheel, with projections set on its rim at the proper intervals, or by the use of other simple devices. A hole 4 to 6 inches in depth is then made with a dibble to receive the plant. Unless the soil is already thoroughly wet, the holes are filled with water. The soil quickly puddles after the water has been applied, and the plant should be set immediately. The roots should be placed in the puddled mass and before all of the water has been absorbed by the soil. The surrounding soil is then drawn about the roots and stalk of the plant and firmly pressed, so that the plant is maintained in an erect position, allowing the bud to remain just above the surface.

If possible, transplanting should be done on a cloudy or rainy day or in the afternoon, so as to avoid excessive wilting. It requires several days for the plants to recover from the shock due to transplanting, but as soon as practicable all plants that have died should be replaced by healthy ones freshly drawn from the seed bed. The field should be gone over at least three times within the first two weeks, for it is important to obtain as nearly a perfect stand as possible. Damage from cutworms must be guarded against, and if they are present constant resetting during the first three weeks may be necessary.

After the field has been set about a week, cultivation should begin and should be maintained as long as the size of the plants permits. Ordinary surface cultivation to maintain a loose, fine mulch about the plant, with frequent hoeing to keep down weeds, is essential. Cultivation should be shallow, especially in the later stages of growth, to avoid injury to the roots of the plant.

When about one-half of the plants in the field have developed seed heads, but before these have bloomed, " topping " should be done.

This consists of breaking off the top or crown of the plant at about the third sucker or branch below the seed head, so as to allow the plant to develop the lower leaves more fully. After topping, suckers or lateral branches will soon develop in the axis of the leaves, and these should be removed by hand before they become large enough to retard the development of the leaves. In topping and suckering, the field must be gone over two or three times, the aim being to cause all of the plants in the field to mature at about the same time, and hence those plants developing a seed head later than the average should be topped lower.

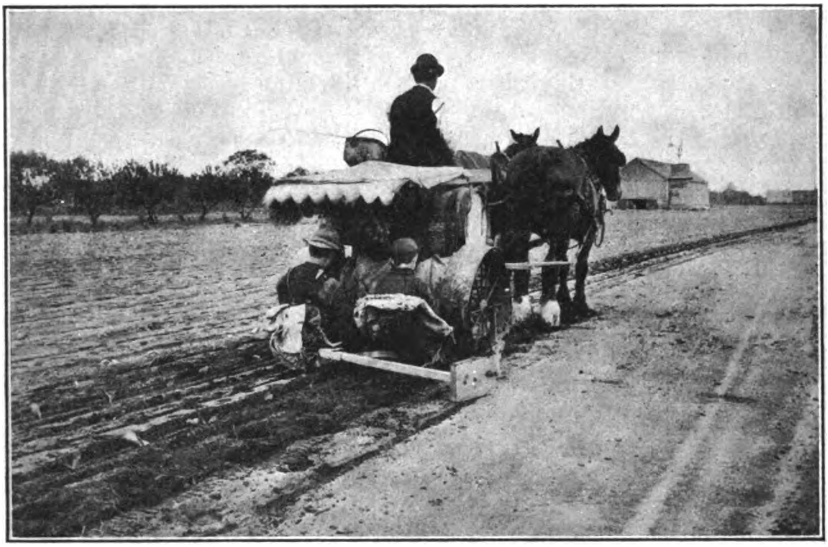

FIGURE 2.—Transplanting tobacco with a horse machine

HARVESTING

Either of two methods of harvesting Havana Seed tobacco may be used. The one most commonly practiced is to cut the whole plant when the middle leaves are " ripe," i. e., when the leaves have assumed a lighter shade of green and have thickened so that upon folding a section of the leaf it creases or cracks on the line of folding. In harvesting the plants, the stalk is cut near the ground with a light hatchet, knife, saw, or a special form of long-handled shears, and the plant is carefully laid upon the ground, where it is allowed to remain until the leaves have wilted sufficiently to avoid much breaking in handling. It is then hung upon a lath 4 feet long by piercing the stalk near its base with a removable metal "spearhead" placed on the end of the lath and sliding the stalk on the lath. As a rule, six plants should be hung on a lath and distributed evenly. Instead of spearing the stalk it may be hung upon the lath by means of a hook or a nail driven through the lath at a sufficient angle to hold the plant securely. Six hooks or nails are put at equal distances on the lath, the three on one side alternating with those on the opposite side. The method of harvesting by cutting and spearing the stalk on the lath is shown in Figure 3.

The laths carrying the plants should be placed upon a rack and hauled to the curing barn, where they are hung in tiers with a space of 6 to 10 inches between the laths.

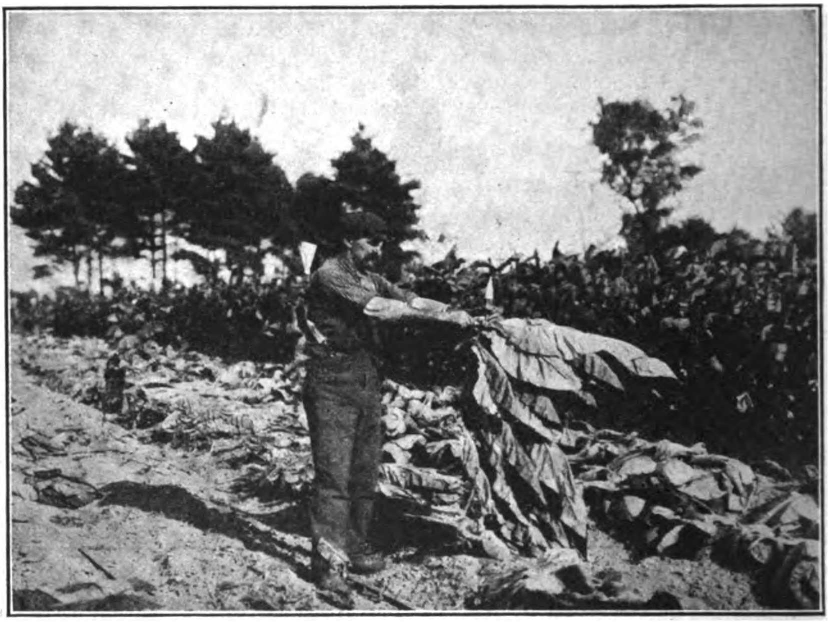

FIGURE 3.—Harvesting tobacco by cutting the stalk, showing the method of spearing the plant on the stick

In the second method of harvesting Havana Seed the leaves are picked from the plant as they ripen. The degree of ripeness is not so advanced as that described for stalk-cut tobacco. The proper degree of ripeness is very important, for upon this largely depends the development of the desirable qualities of texture, body, color, elasticity, etc., during the process of curing. A safe guide is to take the first picking at the time the seed head forms, and subsequent pickings at intervals of six days. Five pickings should be made, the first one comprising the lower four leaves of commercial size and, proceeding upward on the plant, the second and third pickings each including three leaves, and the fourth and fifth pickings three or four leaves each. As the leaves are taken from the plant they should be laid in the row and then carried by an attendant in baskets to the curing barn. Here, by means of a large needle, a string is passed through the stem of the leaf near its base, one end of the string being attached to the end of the 4-foot lath, and when the string is full the free end is attached to the other end of the lath. Each lath should carry 36 to 40 leaves, and the leaves should be put on in pairs, so that they are back to back and face to face. The laths should be spaced 5 inches apart in the curing barn.

CONNECTICUT BROADLEAF

The methods of preparing the seed bed and the land are the same for Broadleaf as for Havana Seed. In setting Connecticut Broadleaf in the field, the distance between plants should be greater than in the case of the Havana Seed on account of the larger size of the leaf of the former. The best distance for setting the plants in the row is 20 to 24 inches, and the rows should be from 3 feet 3 inches to 3 feet 9 inches apart, but otherwise the cultural methods to be followed are about the same as for Havana Seed. The same fertilizers are to be used as for Havana Seed. The Broadleaf should be harvested by cutting the stalk in the manner described for Havana Seed.

COMSTOCK SPANISH OR WISCONSIN HAVANA SEED

The Comstock Spanish variety, along with the ordinary Havana Seed, is specially adapted to the production of binder leaf in Wisconsin. The seed beds should generally be sown during the latter half of April. Barnyard manure is used with good success in fertilizing the tobacco soils, but thus far commercial fertilizers have been used more sparingly than in the Connecticut Valley. Transplanting from the seed bed to the field under normal conditions should be done during June, more commonly during the latter half of the month. The rows should be 34 to 38 inches apart and the plants should be set 18 to 20 inches apart in the row. Harvesting, which is done by cutting the stalk in the manner described for Havana Seed, should begin about three weeks after topping.

SHADE-GROWN WRAPPER LEAF

In the production of high-grade cigar-wrapper leaf under artificial shade, selected strains of Cuban are used in the Connecticut Valley while in the Florida-Georgia district the so-called Big Cuban and Round Tip and certain new, disease-resistant strains derived from these have been chiefly grown in recent years. The artificial shade consists essentially of a wire frame about 8 feet high supported by stout posts, over the top and sides of which the cloth or slat shading material is spread. For cloth shade the posts are usually spaced 27 to 33 feet apart so as to form uniform bents or squares across the field, except that in the outside rows the spacing is closer. For slat shade the spacing is 18 by 22½ feet or 13½ by 27 feet and in the outside rows on two sides the posts are only 2 or 4 feet apart. In the Connecticut Valley cloth is the only shading material used, while in the southern district either cloth or slats similar to plastering laths, or a combination of the two, are employed. In both districts, however, cloth is used for the side walls. The cloth is a coarse loosely woven material containing 8 to 12 threads to a linear inch, with reinforcing bars at frequent intervals, and comes in strips 27 to 33 feet wide. The cloth is stretched over the framework and sewed to the supporting wires. It is placed in position in the spring prior to transplanting and is removed after the crop has been harvested. The slats employed for shading are 48 or 52 inches long and 1½ inches wide and are spaced 3 to 6 inches apart, depending on whether they are used alone or in combination with cloth. The slats are held in place on the wires supporting them at the ends and in the center by double-wrapping with a finer wire. In the combination shade the cloth is placed beneath the slats and supported by wires.

In the Connecticut Valley the system of fertilizing, including use of manure, is similar to that outlined for Connecticut Havana Seed. In the Florida-Georgia district 10 to 15 tons of manure per acre are used whenever available. In addition, commercial fertilizers are used in quantities to furnish a total of about 275 pounds of ammonia, 215 pounds of phosphoric acid and 240 pounds of potash per acre, including the quantities of these nutrients supplied by the manure. The fertilizer materials most used are about the same as those suggested for the Connecticut Havana Seed. In transplanting, the rows are spaced 3¼ to 4½ feet apart and the plants are set 10 to 15 inches apart in the row. The plants are topped very high, the flower head being removed before the blossoms open. The crop is harvested by the priming method as described for Havana Seed, the first picking of about 3 leaves being made at time of topping. Subsequent pickings of 3 or 4 leaves each are made at increasing intervals up to 7 to 10 days or longer between the fourth and the fifth pickings.

CIGAR-FILLER LEAF

Domestic cigar-filler leaf is produced mainly in the Lancaster (Pa.), the Miami Valley (Ohio), and the Onondaga (N. Y.) districts, and in restricted areas of Florida and Georgia. The best filler-leaf soils, mostly loams, are decidedly stronger than those adapted to wrapper leaf, containing more silt and clay and retaining larger percentages of water. In the main, these soils are well adapted to general farming, and the tobacco is, or should be, grown in rotation with other crops. Cultural methods differ principally from those followed in the wrapper districts, in that the plants are spaced farther apart in the field and are topped lower so as to obtain a heavier leaf, and the tobacco is allowed to become riper before it is harvested. In general, less intensive methods are followed than in the wrapper districts, since filler leaf commands only moderate prices.

PENNSYLVANIA BROADLEAF

The typical filler soils of the Lancaster district are the Hagerstown and the Conestoga loams, which are of limestone origin. The method of preparation and the care of the seed bed are essentially the same as in the wrapper districts. The seed usually should be sown during the first half of April, and transplanting, which is generally done with a horse transplanter, should take place through the month of June. The soil needs to be put in good condition by plowing and harrowing. Stable manure should be used liberally, usually at the rate of 10 loads or more per acre. As a supplement to the manure, a commercial fertilizer consisting of about 500 pounds of cottonseed meal, 300 pounds 16 per cent superphosphate, and 100 to 200 pounds sulphate of potash per acre, or other similar mixture, usually will improve both the yield and the quality of the crop. The rows should be 3 to 3½ feet apart, and the plants should be set 24 to 30 inches apart in the row. The better practice is to top the plants before the flower head begins to bloom, and a smaller number of leaves should be left than in the case of wrapper types. The suckers must be promptly removed as they develop. The tobacco must be allowed to become full ripe, as judged by the signs indicated for the wrapper type, and should be harvested by cutting the stalk at its base and spearing it on laths, as described for Connecticut Havana Seed.

ZIMMER SPANISH

The Zimmer Spanish variety is grown principally in the Miami Valley of Ohio. The principal soil types have been designated as "Miami clay loam," and "Miami black clay loam." The Zimmer Spanish, so called, seems to be practically identical with Havana Seed, as has already been stated. The seed beds are best sown during the latter part of March and through April. Transplanting should be done during the first three weeks of June. Commercial fertilizers should be used freely, and good results are obtained in applying as much as 1,000 pounds per acre of a mixture analyzing about 4 per cent nitrogen, 9 per cent phosphoric acid, and 8 per cent potash—that is, one supplying about 40 pounds of nitrogen, 90 pounds of phosphoric acid, and 80 pounds of potash. Barnyard manure also gives good results. The rows should be placed 34 to 38 inches apart and the plants set 28 to 32 inches apart in the row. The plants should be topped before blooming and should be kept free from suckers. The time and method of harvesting are about the same as for Pennsylvania Broadleaf.

FLORIDA SUMATRA

The Florida Sumatra variety is grown for filler and wrapper leaf in the southern cigar-tobacco districts. The best results are obtained on soils somewhat heavier than the types best adapted to wrapper leaf. The seed bed is burned to destroy weed seeds, as is described for the export and manufacturing types. The seed may be sown in January or February. A commercial fertilizer analyzing about 5–4–5 should be applied to the bed at the rate of about 2 pounds per square yard of surface. The seedlings are ready for transplanting when they are 4 to 5 inches high. The tobacco land should be plowed in the fall and must be liberally fertilized. When 15 or 20 loads of manure per acre are applied, a mixture of 600 to 800 pounds of cottonseed meal, 400 pounds of superphosphate (acid phosphate), and 200 pounds of sulphate of potash usually gives good results. The rows are made 3 to 3½ feet apart and the plants are set 14 inches apart in the row. The plants should be topped to 12 to 16 leaves, and the suckers are removed as often as they appear. The tobacco should be harvested just before it becomes fully ripe. For filler leaf the proper method of harvesting is by cutting the stalk, but when there is promise of obtaining a considerable percentage of wrapper leaf the harvesting is done by picking the leaves as they ripen, in the manner described for Connecticut Havana Seed.

THE CULTURE OF THE EXPORT AND MANUFACTURING TYPES

EXPORT AND MANUFACTURING TOBACCO VARIETIES

White Burley is a distinctive variety, producing a type of cured leaf known by the same name, practically all of which is used in domestic manufacture. This variety, of which there are several subvarieties, such as the Stand-Up and Twist Bud, is grown mainly in north-central Kentucky, eastern Tennessee, southern Ohio, southwestern West Virginia, and southeastern Indiana. Aside from its peculiar chlorotic appearance, Burley more closely resembles the cigar seed-leaf group than the other export and manufacturing varieties (except the Maryland).

The Maryland is another fairly distinctive variety, in many respects resembling the cigar seed-leaf and White Burley varieties. The type of leaf produced is known as Maryland tobacco. Two subvarieties of the Maryland are known as Broadleaf and Narrowleaf, respectively.

In the production of the remaining types of export and manufacturing tobaccos, such as the flue cured and fire cured, a very large number of so-called varieties are used more or less interchangeably. Nearly all of these may be regarded as coming under two principal groups, namely, Orinoco and Pryor, although in many cases the distinctions between the strains or subvarieties are so slight as to make it impossible to determine in which of the two groups each really belongs. Of the Orinoco group may be mentioned the Big Orinoco, Little or Narrow-Leaf Orinoco, White-Stem Orinoco, Lizard Tail, Gooch, and Flanagan. Among the group of Pryors there are the Blue Pryor, Yellow Pryor, White or Medley Pryor, and Silky Pryor. Two additional varieties or subvarieties of the export and manufacturing tobaccos of importance are the Yellow Mammoth and One Sucker.

FIRE-CURED EXPORT TOBACCO

The fire-cured export type of tobacco is grown almost exclusively in western Kentucky and Tennessee and in central Virginia. Its principal characteristics are its dark color, heavy body, and a distinctive flavor imparted to it from the smoke of the open fires used in curing. By far the greater portion of this type is exported, but it is also used for production of snuff and as a plug wrapper. The soils producing the fire-cured export leaf are heavy, containing a high percentage of clay or silt, and hence would not be adapted to the culture of most other types of tobacco. The principal varieties used in producing the fire-cured tobacco are the Pryors, the Yellow Mammoth, and the Orinocos.

THE SEED BED

A well-drained friable soil having a southern or eastern exposure is to be preferred for the seed bed, and when practicable a suitable spot in the woods is chosen. Selecting a time, after removing the forest growth, when the soil is not too wet, it is burned to destroy weed seeds and insects. A good method is to lay small poles or skids over the area to be burned, at intervals of 3 feet, and to pile brush and wood on one end of the skids. After setting fire to the brush the burning material is pulled forward on the skids as rapidly as the soil becomes sufficiently heated and sterilized to a depth of 2 or 3 inches. After removing all débris, the soil is thoroughly spaded or plowed to a depth of a few inches. Where the necessary equipment is available the method of steam sterilization referred to on page 4 gives excellent results. Before seeding, a commercial fertilizer analyzing, say, 8 per cent phosphoric acid and 3 per cent nitrogen and potash should be applied at the rate of 1 or 2 pounds per square yard. In sowing, the seed should be mixed with a large volume of fertilizer, corn meal, or sifted ashes (about 2 quarts for each teaspoonful of seed), in order to secure an even distribution of the seed. A heaping teaspoonful of seed is sufficient to sow 25 square yards of seed bed, and should furnish enough plants to set an acre in the field. The seed beds may be sown in January, February, or March. The seed must be covered only very lightly, and it is better simply to press the soil down firmly by trampling or with a board or roller. The bed should be surrounded with logs or boards set on edge to a height of 6 to 10 inches to form a coldframe, over which are stretched wires to support the cheesecloth which is to be placed over the frame before the plants come up. The precautions regarding watering and hardening the plants prior to transplanting, as described for the cigar types, are to be carefully followed.

TRANSPLANTING AND CULTIVATING

Prior to transplanting, the land should be thoroughly fitted by plowing and harrowing, after which the rows are laid off, the preferred distance between rows being 3½ feet. In Kentucky and Tennessee the plants are usually set in checks; that is, they are set 3½ feet apart each way, whereas in Virginia they are generally spaced 2½ to 3 feet apart in the row. The accurate spacing of the plants may be readily attained by using a simple marking device, which is drawn across the field so as to indicate the points at which the plants are to be set. Throwing up slight ridges for the rows will remove the danger of the young plants being drowned in case of heavy rains. Transplanting is done mostly by hand and in much the same way as has been described for the cigar tobaccos. Fertilizers should be applied in the process of preparing the land for transplanting. But little barnyard manure is available in the fire-cured districts, and commercial fertilizers are generally used rather sparingly, the usual application being 200 to 600 pounds per acre of a mixture containing about 3 per cent nitrogen, 8 per cent phosphoirc acid, and 3 per cent potash. Much larger quantities of fertilizer will give better results in most cases. A clover sod plowed under in the fall gives good results with this type of tobacco.

Cultivation should begin as soon as the plants start to grow and should continue as long as the size of the plants will permit. The first cultivation is deep, after which frequent shallow cultivations are most desirable. Where the plants are set in checks they may be cultivated both ways, so as to reduce the amount of hand-hoeing required to keep down weeds.

TOPPING AND SUCKERING

When 10 to 15 leaves have appeared on the plant the top should be broken out, so as to force all the growth into the leaves left on the plant and cause them to grow larger, thicker, and darker. A favorite practice is to pick off and discard 3 or 4 of the bottom leaves, and then top the plants so as to leave 8 to 12 leaves on each plant. High topping tends to delay maturity and to produce a thinner leaf. The aim in topping is to leave only as many leaves on the plant as it can bring to the fullest development and as far as possible to insure that all plants will mature at about the same time. The suckers which develop in the axils of the leaves must be removed as often as they appear.

HARVESTING

The plants generally are ready for harvesting in from 30 to 40 days after topping. At this stage the leaves will have taken on a lighter color and become thick and heavy, and small yellow flecks will have appeared, especially near the edges of the leaf. It is not desirable to harvest the tobacco for two or three days after a heavy rain, as the gum which accumulates on the leaf in dry weather and improves its quality is washed off by the rain. In harvesting, the stalk should first be split with a knife from the top down to within a few inches of the bottom, in such a way as not to cut or injure the leaves. The stalk is then cut off near the ground and laid on the ground to wilt sufficiently to permit handling without breaking the leaves. The plants should then be placed astride sticks and hauled to the curing barn. In Virginia the plants are usually placed on the sticks before being laid on the ground to wilt. The sticks are 4 feet 4 inches long, and five to eight plants, depending on their size, should be placed on each stick. The sticks carrying the plants should be arranged on the tier poles of the curing barn at intervals of 6 to 8 inches.

WHITE BURLEY TOBACCO

White Burley tobacco reaches its highest state of development on the limestone soils in the famous bluegrass section of Kentucky, in the eastern Tennessee district, and in southern Ohio. This variety is light in color and body and possesses an exceptionally large absorptive capacity for the liquid flavoring materials used in the manufacture of plug tobacco. Burley is now a very important cigarette type.

The methods of preparing, sowing, and caring for the seed beds are about the same as those described for the fire-cured export tobacco. Burley tobacco gives the best results when grown on virgin soil or on a bluegrass sod which has been standing for at least six or eight years. Under these conditions two or three excellent crops of tobacco can be obtained, after which, unless root-rot resistant strains are planted, the results are unsatisfactory until the land has again stood in bluegrass for several years. In preparing the land, a bluegrass sod should be turned under in the fall and thoroughly cultivated with a disk harrow in the spring. On a heavy bluegrass sod, manure or fertilizers are seldom required for the tobacco. Under other conditions 400 to 800 pounds per acre of a fertilizer analyzing 8 per cent phosphoric acid, 4 per cent nitrogen, and 4 per cent potash usually give profitable returns. If manure is used liberally the nitrogen content of the fertilizer may be reduced.

Burley tobacco plants should be set 14 to 18 inches apart in the row, with the rows 3½ feet apart. Transplanting by machine has proved very satisfactory. Cultivation should be shallow, frequent, and thorough. The tobacco must be topped comparatively high, from 14 to 18 leaves being left on the plant. Careful attention must be given to the removal of the suckers. The crop should be harvested in the same manner as the fire-cured export tobacco, except that when cut it is preferred that the plants be immediately placed astride the stick, one end of which is forced into the ground at an angle in such a position that the stick bearing the plants rests on the stubble of a severed plant. The tobacco is to be left in this position till wilted and then carried to the curing barn. The sticks bearing the plants should be placed 8 to 10 inches apart on the tier poles.

FLUE-CURED TOBACCO

The flue-cured type of tobacco, frequently spoken of as bright tobacco, is grown extensively in the eastern counties of South Carolina, in the northern and eastern counties of North Carolina, and in southern Virginia, and more recently has been successfully introduced into southern Georgia and northern Florida. It is used largely in the manufacture of cigarettes, smoking and plug tobacco, and for export. The bright color of the leaf is due mainly to the character of the soil upon which it is grown and to the methods of curing. The typical soils are light sands and sandy loams with yellow or red sandy and sandy loam subsoils containing relatively small proportions of clay, except in the Piedmont region, where the subsoil is distinctly clayey. The varieties most used in growing flue-cured tobacco are strains or subvarieties of the Orinoco and the Pryor groups, such as Little Orinoco, White-stem Orinoco, Cash, Warne, Gooch, Adcock, Yellow Pryor, and Flanagan.

The methods of preparing and caring for the seed beds and fitting the land are essentially the same as for the fire-cured export tobacco. The rows should be laid off 3½ or 4 feet apart and the plants set 20 to 30 inches apart in the row. Transplanting should begin about the first of April in South Carolina and Georgia and extend into May or even June in the western portions of the North Carolina district. The bright-yellow color of this type is one of its most valued characteristics, and for this reason large quantities of nitrogenous fertilizers must be avoided. The soils producing the best quality of leaf are naturally infertile, and commercial fertilizers are freely used with profit, although the proportion of nitrogen in the fertilizers must be kept comparatively low.

In the eastern or coastal plain portion of the flue-cured district, where the soils are generally more sandy, a somewhat heavier rate of application of fertilizer is required than in the Piedmont region. Superphosphate is a suitable source of phosphoric acid in the fertilizer. It is recommended that one-half of the nitrogen or ammonia of the fertilizer be derived from nitrate of soda or urea and the remaining half from two or more standard organic sources, such as fish scrap, cottonseed meal, and high-grade tankage. Ammonium sulphate may be used to replace one-half the nitrate of soda or urea. The potash should be derived from high-grade sulphate or sulphate of potash-magnesia and high-grade muriate in such proportions that the fertilizer will not contain more than 2 per cent chlorine. The use of sulphate of potash-magnesia in the fertilizer has the advantage of furnishing both potash and magnesia. (See p. 22.) For average conditions a combination of the above-named materials in quantities sufficient to furnish the equivalent of 800 to 1,200 pounds per acre of a fertilizer analyzing 8 per cent phosphoric acid, 4 per cent ammonia, and 6 per cent potash is recommended for the coastal plain section. For the Piedmont section a mixture of these materials equivalent to 800 to 1,000 pounds per acre of a fertilizer of the same analysis, or one containing somewhat less ammonia and potash, is suggested. Under some conditions the application of lime to tobacco lands may be beneficial to other crops grown in the rotation, but the direct effect of lime on the tobacco crop may be somewhat injurious except where dolomitic limestone is used to supply magnesium as a remedy for the sand-drown disease. Light applications of well-rotted manure in the fall or early spring are beneficial as a supplement to commercial fertilizer.

The methods of cultivation are similar to those used for fire-cured tobacco. When the flower heads begin to show, the plants are topped. In the Piedmont section 8 to 12 or more leaves are left on the plant, depending on the richness of the soil and the vigor of the plant. In the coastal plain section the plants are topped somewhat higher, leaving 12 to 16 or 18 leaves to the plant. The suckers must be removed at intervals of a week or 10 days, and it may be necessary to go over the field five or six times.

Flue-cured tobaccos should be thoroughly ripe when harvested. The leaf surface should show numerous patches of a light-yellow color, and even the green portions should be of a light tint; otherwise it will be difficult or impossible to cure the leaf properly. In the eastern portion of the flue-cured districts the preferred method of harvesting is to pick off the leaves as they ripen, beginning at the bottom of the plant and taking two or three leaves at each picking. The leaves should be taken to the barn and attached in small bunches to the sticks by means of strings. The string is attached to an end of the stick and near this end it is passed once around the stems of three to five leaves, thus forming a small bunch which will hang to one side of the stick. The string is then drawn diagonally to the opposite side of the stick and similarly looped around a second bunch of leaves and the process repeated until the stick is full, when the free end of the string is attached to the other end of the stick. In the western portion of the flue-cured district the method formerly used was to harvest the tobacco by splitting the stalk, cutting it off at the base, and placing it astride the stick, as in the case of fire-cured and Burley tobacco. In recent years, however, harvesting by picking the leaves has been extensively practiced in the western portion of the flue-cured district. The field must be gone over from two to four times in order to get all of the plants at the right stage of ripeness.

DARK MANUFACTURING TOBACCOS

In the portion of Kentucky and Tennessee lying between the Burley district and the dark fire-cured sections, types of tobacco are produced in large quantities suitable for domestic manufacture into chewing and smoking tobacco. These types are mostly air cured, like Burley, but in other respects the methods of production are quite similar to those followed for the dark fire-cured tobacco. In the southern portions of this territory, centering around Warren County, Ky., the so-called One Sucker variety is extensively grown and the type of leaf produced is known by the same name.

In the few counties of Virginia in the vicinity of Richmond a type of leaf long known as Virginia Sun-Cured is produced. Formerly the tobacco was exposed to the sun in the process of curing (hence the name), but at the present time air curing as practiced in the Burley district is the more common method. This type is specially adapted to the manufacture of chewing tobacco. Aside from the curing and somewhat higher topping, substantially the same methods of production should be followed as have been outlined for the fire-cured export tobacco.

The Maryland type is produced extensively in the section lying between the Potomac River and Chesapeake Bay known as southern Maryland. This tobacco is light in body and color, of a dry or chaffy character, and has good burning qualities. Maryland tobacco is an export type and goes mostly to France, the Netherlands, and Germany, although in recent years it is being used more and more in the domestic manufacture of cigarettes. The broadleaf varieties do best on light land, whereas the narrowleaf sorts are grown mostly on the heavier soils. The Maryland Mammoth variety gives large yields and excellent quality on the more productive soils but is not profitable on land of medium or low productivity.

The tobacco soils of Maryland are sandy or silty in character, the soil and subsoil being gray or yellow in color, and are usually deficient in humus. When available, stable manure gives good results. The use of commercial fertilizers is increasing. For average conditions 500 pounds per acre of a fertilizer analyzing 6 per cent ammonia, 8 per cent phosphoric acid. and 6 to 10 per cent potash gives good results.

The tobacco may be conveniently set in squares, the plants being spaced 32 to 36 inches apart each way. Cultural methods are about the same as for other types. The plants are topped at 16 to 20 or more leaves, depending on the vigor of the plants and the seasonal conditions. The tobacco matures in two to four weeks after topping, and should be harvested by cutting the stalk and spearing on a stick, as described for the cigar-leaf types. A field of Maryland tobacco nearly ready for harvesting is shown in Figure 4.

TOBACCO DISEASES AND THEIR CONTROL

The tobacco plant is attacked by a number of diseases, but only some of the more important ones can be considered in this bulletin.

SEED-BED SANITATION

Prevention rather than cure is the keynote in the control of most tobacco diseases. Several of the more important diseases such as mosaic and bacterial leaf spots commonly originate in the seed bed and, consequently, special effort should be made to prevent infection in the young seedlings. The seed bed preferably should not be located near curing barns, tobacco fields, or weedy areas. It is very important that no old tobacco material of any sort be allowed to reach the bed. Unless woods land is used for the seed bed the soil should be sterilized, preferably by thorough steaming as described in Farmers' Bulletin 1629, Steam Sterilization of Seed Beds for Tobacco and Other Crops. Unless new, the frames and covers of the seed bed should be disinfected by spraying with a solution of formaldehyde, corrosive sublimate, or other disinfectant, by steaming or by boiling in water. It is a mistake not to carefully examine the tops and roots of the seedlings for evidence of disease at the time of transplanting. As a rule it is best not to use plants from beds in which any of the dangerous parasitic diseases are present.

ROOT ROT

One of the most important and widespread diseases affecting the plant is known as black root rot. Usually this disease can be readily recognized by carefully examining the roots, which are seen to be more or less decayed, the smaller roots especially showing blackened portions. The plants do not start to grow properly and may wilt in sunshine even though the soil is moist. The symptoms above ground often merely suggest an infertile soil, need of fertilizer, too much water, and the like. This disease is due to a fungus (*Thielavia basicola*), which persists in the soil from year to year and in addition to tobacco attacks cowpeas, the clovers, and other legumes. Cool weather, such as occurs in a late wet spring, greatly favors the disease, while very hot weather may soon check it, causing the plants to develop new roots near the surface of the ground, where the soil is warmest, and to begin growing.

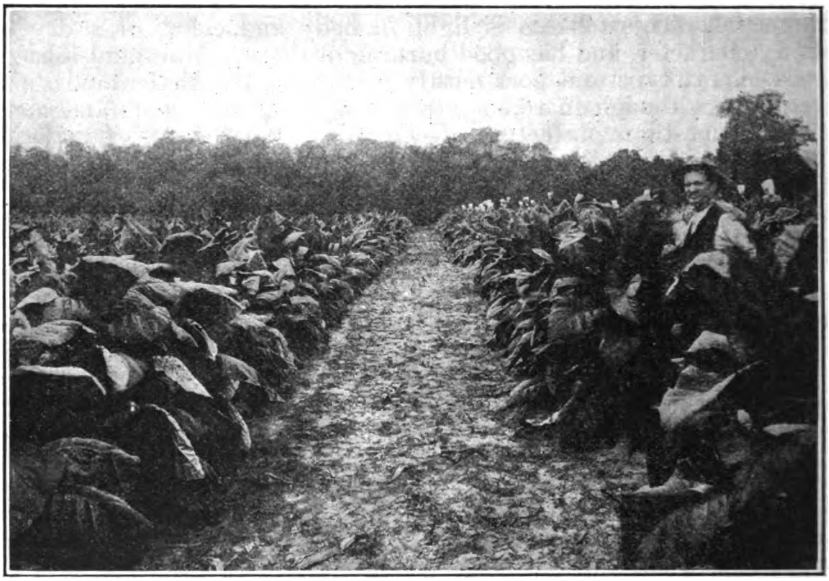

FIGURE 4.—Field of tobacco in Maryland that has been topped and is nearly ready for harvesting. On the right are shown seed heads of selected plants covered with bags to prevent crossing

The disease may be controlled in the seed bed by sterilizing the soil through the use of steam or of formaldehyde. Diseased seedlings should never be set in the field, for this may be a means of spreading the trouble. The ordinary varieties of White Burley tobacco are very susceptible to the disease, but highly resistant strains of Burley as well as of some of the northern cigar-tobacco varieties have been developed recently and may be successfully grown on diseased land. Resting the land for several years or the rotation of crops (avoiding legumes) will tend to reduce the injury from root rot.

On many soils tobacco may be grown very successfully in rotation with various other crops, but on other types of soil certain crops when preceding tobacco in the rotation may have a serious depressing effect on growth of the tobacco. In this case the roots of the tobacco are not fully developed and have a brown or yellow color, hence the trouble has come to be known as brown root rot. Among the crops likely to produce this effect on tobacco are timothy, rye, corn, and the common legumes. The exact nature of this unfavorable crop effect is not fully understood. It is not corrected by heavy fertilizing or by liming. Continuous culture of tobacco or resting the land tends to obviate or correct the trouble, and continuous culture combined with use of strains of tobacco resistant to the black root rot may make possible the control of both forms of root rot.

THE TOBACCO WILT (GRANVILLE WILT)

Tobacco wilt, or the Granville wilt of tobacco, is a serious bacterial disease that attacks a number of plants besides tobacco. The germ enters the plant through the roots, and multiplies so rapidly that the water-conducting vessels become clogged, causing the leaves to wither and perish. The woody portion of the stalk shows a yellowish to black streak when the bark is stripped off. The disease occurs chiefly in Granville County and the adjoining counties of North Carolina and in the cigar-tobacco district of western Florida. Fertilizers have nothing to do with the occurrence of the wilt. The systematic and persistent rotation of crops is the only successful method of combating the disease. Crops that are attacked should not be planted, and tobacco must not be grown on the land oftener than once in four or five years. Corn, cotton, sweetpotatoes, redtop or herd's grass, and other grasses, cowpeas, wheat, oats, rye, and the clovers are immune and may be used in the rotation. Resting the land will not give good results, because ragweed, which is so common on tobacco fields, is attacked by the wilt organism.

ROOT KNOT

Tobacco may be severely injured on light sandy soils in the South by a minute eelworm or nematode which bores into the roots, causing them to develop galls or swellings; hence the name "root knot," commonly applied to this trouble. The disease is easily recognized by examining the roots. The growth of the plant is retarded and in some cases the leaves turn yellow. This disease is readily controlled by rotation of crops, provided the highly resistant crops are used and a crop of tobacco is grown only every third or fourth year. The Iron and Brabham varieties of cowpeas, velvetbeans, corn, wheat, oats, rye, sorghum, peanuts, and grasses may be used in the rotation, but most other crops, including cotton and the ordinary varieties of cowpeas, should be avoided.

SORE SHANK

In the fungous disease known as "sore shank" the stem of the plant undergoes a decay at the surface of the ground and usually the plant finally topples over. There may be no indication of the disease to the casual observer until the plant suddenly withers or is blown over by the wind. As a rule, damage from this disease is small, since only a plant here and there in the field is affected, but serious outbreaks occasionally occur. Occasionally a peculiar wilting and dying of the lower leaves, perhaps only the portion of the leaf on one side of the midrib being affected, is seen in this disease. If the trouble becomes serious, rotation of crops may be resorted to as a remedy.

MOSAIC, CALICO, OR WALLOON

One of the most widespread maladies of the tobacco plant is known as mosaic, calico, or walloon. The chief symptom is a mottling of the leaf, portions of which are of a lighter green color than the remaining portions, and this mottling may extend also to the blossoms. In severe cases of the disease there may be various malformations and distortions of the leaves. The disease is highly infectious and may be communicated from diseased to healthy plants by laborers in transplanting, topping, or suckering. Tobacco plants are seldom killed by mosaic, but both the yield and the quality of the crop may be injured. The disease may be carried over in the soil. Care should be taken to avoid spreading it by handling healthy plants after having touched diseased ones.

FRENCHING

Another disease, frequently confused with mosaic, is properly known as "frenching." This disease is not infectious and is due to some unfavorable condition of the soil. In severe cases the leaves of the plant are so long and narrow that they may be spoken of as stringy or ribbonlike, and they are extremely thick and brittle. In milder forms of the malady the leaves are small, narrow, stiff, and stand up in an erect manner. The upper surface of the young leaves shows numerous golden yellow spots, and the leaves are thick. The disease may occur at any stage of development, and often only the upper part of the plant is affected. Defective drainage seems to be a contributory cause of the disease, and it appears that deficiencies in plant food may cause symptoms of the trouble. Correction of the cause of the trouble often leads to the recovery of the plants.

LEAF-SPOT DISEASES

A number of different names have been applied to the leaf-spot diseases of tobacco which have appeared in severe form from time to time in different tobacco-growing sections. Among these names may be mentioned "blight," "fire," "red fire," "wildfire," "red rust," "brown rust," "speck," and "angular leaf spot" or "black fire." It appears that there are several distinct leaf-spot diseases, most of which are due to fungi and bacteria. Observation shows that most, if not all, of these diseases develop in severe form only under a special combination of conditions, so that in any particular locality they are not likely to prove especially destructive, except in certain years and often at rather infrequent intervals. Broadly speaking, the so-called rusts have been most prevalent in northern cigar-tobacco districts, and the red rust or brown rust frequently follows as a sequel to the mosaic disease. The so-called wildfire and the angular leaf spot or black fire, which are very similar diseases, have caused considerable damage in various districts during the last few years. Both are bacterial diseases. They usually appear first in the seed bed, but the materials chiefly responsible for carrying the bacteria through the winter are not definitely known. As an aid in preventing infection in the seed bed it is recommended that the seed be sterilized by soaking for exactly 15 minutes in a solution of 1 part corrosive sublimate (bichloride of mercury) or silver nitrate in 1,000 parts water. The solution should be prepared in a glass or wooden vessel. After treatment the seed must be washed thoroughly and dried promptly at ordinary room temperatures. Corrosive sublimate may be purchased in tablet form at drug stores, and directions for making the solution of proper strength accompany the package. (It is to be remembered that this substance is a deadly poison if taken internally and its use should be properly safeguarded.) The soil of the seed bed should be sterilized by steaming or by thorough surface burning, and the frames and covers may be treated with formaldehyde or steam. Care should be taken to prevent any tobacco trash from infected crops or other organic matter likely to harbor the germs of the disease from reaching the seed bed. No specific remedy for these diseases has been found, once they have attacked the plant, but dry weather usually checks their progress. The tobacco plant is subject to attack at any stage of development, but seems to be particularly susceptible at the time it reaches maturity. The diseases are more destructive in periods of wet weather, and their progress may be rapidly checked by dry clear weather. An abundant supply of nitrogen in the soil or fertilizer and low topping of the plants are predisposing factors toward injury from these leaf spots, while a liberal supply of potash in the fertilizer tends to increase the resistance of the plants to the diseases.

POTASH HUNGER

An insufficient supply of potash in the soil for normal growth and development of the tobacco crop usually produces characteristic symptoms in the leaf which are easily recognized by those familiar with the disease. First indications of this trouble are usually seen on the tips and margins of the lower leaves, but in some cases the tips of the middle leaves are first affected. Beginning at the tip a chlorosis or yellowing of the leaf surface develops that is often followed by the appearance of numerous small specks of dead tissue. The growth of the leaf is uneven, and the surface becomes rough and puckered, the slower growth of the tip and edges causing a characteristic curving downward of these portions. As the disease progresses the margins of the leaf may become torn and ragged, and large splotches of dead tissue develop over the surface. In severe cases the portions of the leaf which remain green assume an abnormally dark, muddy, bluish-green shade. This disease, which is readily controlled by using an adequate supply of potash in the fertilizer, is more commonly seen on light sandy and sandy loam soils, especially in the coastal plain portion of the flue-cured district.

MAGNESIA HUNGER (SAND DROWN)

On some of the light sandy and sandy loam tobacco soils, more especially in seasons of heavy rainfall, pronounced symptoms of disease, due to an insufficient supply of magnesia, make their appearance. This disease is commonly known as sand drown, because it is likely to be more severe on sandy spots in the field and after heavy rains. Some care is required to distinguish between the symptoms of sand drown and those of potash hunger, since both may occur on the same soil and even on the same plants. Sand drown always begins on the lower leaves and at the tips and along the margins of the leaves. The green color is bleached out, leaving the affected leaf surface almost white. Ordinarily the leaf surface remains smooth, and there is less tendency toward spotting or specking than in potash hunger. The leaf margin does not curve downward, as in potash hunger, but in some cases may turn upward. The use of a fertilizer supplying 10 to 20 pounds of magnesia per acre in available form, if applied in the drill, usually suffices for the control of magnesia hunger. Sulphate of potash-magnesia is suitable for this purpose. Dolomitic limestone (high in content of magnesia) applied in the drill at the rate of 1,000 pounds or broadcast at the rate of 2,000 pounds or more is effective. Fertilizers of vegetable origin, such as cottonseed meal and tobacco stems, and manure also tend to prevent the disease.

INSECT ENEMIES OF TOBACCO

One of the most troublesome and expensive features of tobacco culture, particularly in the southern districts, is the control of numerous insects which, if not combated, would oftentimes completely destroy the commercial value of the crop. Among the more important insects attacking the tobacco plant may be mentioned the tobacco flea beetle, the tobacco wireworm, cutworms, the hornworms, or green worms, and the tobacco budworm. Of these the hornworms, or green worms, are usually the most destructive.

For detailed information regarding insects attacking tobacco and methods of combating them, the reader is referred to bulletins on this subject issued by the United States Department of Agriculture.

SELECTING SEED PLANTS AND SAVING THE SEED

The first step in producing a satisfactory crop of tobacco is to use good seed, true to type, and before topping is done the tobacco field should be gone over carefully in search of desirable seed plants. Having definitely decided upon the ideal type of plant desired, only those plants which conform to this type should be selected for growing seed. The advantages of selecting good seed plants will be lost if crossing with other types is allowed to take place. This is prevented readily by covering the flower head with a 12-pound manila paper bag in the manner shown on the title-page of this bulletin. The small leaves and branches just below the flower head proper should be removed and the mouth of the bag securely tied to the stalk just below the flowering branches. Any blossoms which have already opened must be picked off before the bag is placed in position. The bag must be adjusted from time to time to accommodate the growth of the flower head.

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FARMERS' BULLETIN

572

Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.
(In Cooperation with the Department of Farm Management, New York State
College of Agriculture.)

March 4, 1914.

A SYSTEM OF FARM COST ACCOUNTING.

By C. E. LADD, *Agent, Office of Farm Management.*

INTRODUCTION.[1]

The farmer wishes to know how much he is making or losing on his business each year, how much he is making or losing on each crop or class of animals, and how he can improve his business so as to make more money. Cost accounting for the farm is the same sort of work which the large meat-packing companies are doing to learn whether they make a profit on canned goods, smoked meats, etc. The farmer wishes to know whether his wheat pays and whether his cows or orchard pay. These are some of the things which a set of farm cost accounts will show.

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Many farmers are desirous of keeping accounts of this sort, but do not know how to start. Undoubtedly many are deterred from starting because they believe that they do not know enough about bookkeeping and because they have in mind no definite method of procedure. To any such men who desire to keep accounts and who have not worked out a system for themselves, it is believed that the system outlined in this paper will be helpful. Those who are already keeping accounts but are not satisfied with the results obtained may find here some suggestions of value.

Farm cost accounting, of necessity, involves many estimates, but there is no reason why one should lose faith or be discouraged because of them. If the worker has reasonably good judgment and is not prejudiced in favor of any crop or animal he can obtain satisfactory results. The systems of cost accounting in use by the large packing companies and by large wholesale grocery houses involve as many

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[1] This system of farm cost accounting was developed by Prof. G. F. Warren, of the New York State College of Agriculture, on his own farm, where it has been in use for seven years. The principles of it are published in his book entitled "Farm Management." This system has been given a thorough trial for three years with a number of farmers under the immediate supervision of the writer of this bulletin, working jointly for the United States Department of Agriculture and the New York State College of Agriculture.

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estimates and do not give any more accurate results than do well-kept farmers' accounts.

Cost accounts can not be absolutely exact. They contain many estimates. It is foolish to spend time with the refinements in methods of bookkeeping that are designed to check exact work to the last cent. In fact, attempts to find insignificant errors often disgust persons with the whole question of accounting.

Of the desirability of keeping accounts on a farm much has been said in the agricultural press. In an agricultural survey of Tompkins County, N. Y., made in 1907, it was found that 45 per cent of the farmers already keep some sort of records or accounts.

This bulletin simply aims to give a description of a system of farm cost accounting which has been tried for three years in the State of New York with 53 farmers under widely differing conditions and has proved fairly successful. It is a method so simple that a farmer can keep it without assistance.

TIME REQUIRED TO KEEP ACCOUNTS.

The first question which the practical farmer asks about a set of accounts is, "How much time will it take?" The time required is one of the chief objections made to most kinds of farm cost accounting. The farmers who have used this particular system during the past year answer the question of time by estimates ranging from two to ten minutes a day. The average seems to be about five minutes for the daily entries. To this must be added a number of hours of work at the end of the year to close the accounts. This time will vary with the type of farming, the complexity of the business, and the degree of accuracy and completeness with which the accounts have been kept.

BOOKKEEPING KNOWLEDGE UNNECESSARY.

No bookkeeping knowledge is necessary. In all the cooperative work done so far, bookkeeping training, as sometimes given in commercial schools, has seemed a detriment rather than a help. Those trained in commercial bookkeeping have a tendency to insert technicalities and complexity of entry which would be all right for a business house, but which are entirely out of place for a practical farmer who wishes to do cost accounting. It is not necessary to know the difference between a daybook and a journal or to know how to get a trial balance in order to keep good farm cost accounts.

A FAVORABLE TIME TO START ACCOUNTS.

Accounts may be started on an ordinary farm any time after the last crop is harvested in the fall and before the first crop preparations are started in the spring. The exact date will depend upon the geographical location of the farm and the nature of the business or type of farming in practice. The time should be as late as possible, in order that there may be the smallest quantity of last year's crops on hand to be inventoried. However, the date should be early enough to give the farmer sufficient time to close his year's accounts, work out results, plan the next year's business, and start new accounts before the spring crop work begins. In a large majority of cases this date will be January 1, March 1, or April 1. For a tenant the date for taking an inventory will, of course, correspond to the date of his lease.

REQUIREMENTS FOR KEEPING A COMPLETE SET OF FARM COST ACCOUNTS.

In order to have a complete set of farm accounts three records are necessary:

(1) An inventory at the beginning and at the end of the year.
(2) An account of all money paid out or received.
(3) A record of all work done by men and horses during the year.

INVENTORY.

The inventory on an ordinary farm is a matter requiring from two to five hours' work at the beginning and at the end of the year. The same inventory, of course, is used for closing one year's accounts and starting the next, so that this work is done only once a year. This inventory should be a detailed list, with values, of the following: The farm, subdivided into buildings and land, each building being listed separately, with the number of acres of land and its value per acre (the total value of buildings and land listed being equal to the value of the farm); the horses, listed by name and giving their ages, followed by other live stock listed separately, giving value per head; machinery, each item being listed separately, except that small tools may be bunched as one item; quantities of feed, produce, and supplies on hand; growing crops (value of labor and materials already spent for next year's crops); cash on hand and in bank; and bills receivable. The total of all these should be found and the mortgage and bills payable, if any, subtracted from it. The difference is what the farmer is worth above debts, or his present net worth.

In estimating values, the market price at the farm, or the price at the selling place minus the cost of hauling to market, should always be the standard.[1] The value put upon anything should be what it is thought can be obtained for it at a normal sale and should neither be overrated nor underrated. In either case, one is fooling only one's self. It is better to be fair and unprejudiced and use one's best judgment.

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[1] A more complete discussion of this problem of determining values and depreciation is given in Farmers' Bulletin 511, entitled "Farm Bookkeeping," pp. 12-15.

TABLE I.—*A sample summary of an inventory.*[1]

Item.	Mar. 1, 1912.	Mar. 1, 1913.
Farm, 200 acres (including buildings)	$8,000	$8,000
Cows:		
20 head at $60	1,200	
15 head at $70		1,050
Horses, 6	900	850
Machinery	783	800
Feed and supplies	1,100	850
Growing crops (cost of labor and materials)	110	125
Cash	97	437
Bills receivable	75	95
Total resources	12,265	12,207
Mortgages and bills payable	3,125	2,300
Net worth	9,140	9,907
Gain for the year	767	
	9,907	9,907

[1] In the complete inventory each cow, horse, and machine is listed separately.

The form in Table I is presented here as a suggestion as to the way in which the inventory may be classified and summarized after two inventories are completed.

If preferred, the inventories may be kept on pages by themselves in the financial record book and the entering of inventory values to the individual accounts may be deferred until both inventories are complete and the accounts are being closed at the end of the year. The method of entering these amounts is given under "Closing the accounts at the end of the year."

No other account will give so much information for the time and labor expended as the annual inventory. By comparing the net worth as shown by the current inventory with the net worth shown by that of the previous year, the farmer can tell whether he has made a gain or loss and how much, after paying from farm receipts what he has expended for the living expenses of the family.

If money has been added to or taken from the business by gifts or by transfer from some other business that is not included in the inventory, these items would have to be known in order to tell the gain or loss. Usually the farmer lists all his property in the inventory, so that there is no chance for such an error. He may have only a small amount of cash on hand, as the gain may all be invested in a new team, additional cows, or extra feed. On the other hand, the cash on hand may be much larger than the year before, thus making the farmer feel more prosperous, whereas the number of head of stock or the quantity of feed on hand may be so much less that he has actually farmed at a loss that year.

The annual inventory shows the annual gain or loss on the farm business, but it does not show what crops or what animals have made a gain or loss. On nearly every farm where accounts have been kept, the gain or loss for the year resulted from losses on several accounts and gains on several accounts. In every case the farmer was much surprised to see which accounts showed a gain and which a loss. Results like these can only be shown by a complete system of accounts.

FINANCIAL RECORD.

A record of the receipts and expenditures on the farm is necessary for a complete set of accounts. For this purpose a book called by stationers a "broad daybook," or "journal," is used. The requirements are that there be a place for a date on the left-hand side of the page, a broad space in the middle of the page in which to write explanations, and columns ruled for dollars and cents at the right. The page is ruled and items are entered as shown in the sample account with potatoes in Table II. The financial record book at the end of the year becomes the completed account book and will have a summary of labor entered in it from the work record as described later.

A separate account is kept with real estate, each crop grown, each class of animals, machinery, labor, interest, persons dealt with, bills payable and bills receivable, and with such other items as may be found necessary or convenient.

The items that make up bills payable and bills receivable should be listed in the inventory at the end of the year, as mentioned, either from memoranda or in any other way which may be found convenient. In closing out the inventory at the end of the year, the items for which money is due or owing should be charged or credited to their respective accounts. When these bills are settled, during the early part of the following year, the entries should be made under bills payable or bills receivable, as the case may be.

In this book two pages facing each other are taken for each account. The name of the account is written at the top of the page. The right-hand page is marked "Credits" and is used only to record credits to the account. The left-hand page is marked "Charges" and is used only for charges against the account. The pages then appear as shown in the sample account with a crop of potatoes (Table II).

TABLE II.—*A sample account with potatoes in a 14-acre field.*[1]

Charges.			Credits.		
1913.	Item.	Amount.	1913.	Item.	Amount.
June 3	Seed, 160 bushels, at 45 cents	$72.00	Oct. 5	Sold, 226 bushels, at 60.18 cents	$136.00
4	Corrosive sublimate, 3 ounces	.30	20	Sold, 510 bushels, at 62 cents	316.20
10	Seed, 43¾ bushels, at 55 cents	24.06	Nov. 1	Sold, 241 bushels, at $1.083	261.02
11	Corrosive sublimate, 6 ounces	.60		Saved for seed, 135 bushels, at $1	135.00
July 12	Paris green, 6 pounds	1.32		Saved for home use, 16 bushels, at 60 cents	9.60
15	Lead arsenate, 160 pounds	14.40		Residual manure, 60 per cent of 1911	18.00
	Use of land, 5 per cent on $100 per acre	70.00		Residual manure, 30 per cent of 1910	6.00
	Man labor, 796 hours, at 19.02 cents	151.40			
	Horse labor, 839 hours, at 10.46 cents	87.76			
	Equipment labor, 839 hours, at 3.5 cents	29.36			
	Manure, 60 per cent of 1910 application	12.00			
	Manure, 100 per cent of 1911 application	30.00			
	Total charges	493.20			
	Gain	388.62			
	Grand total	881.82		Total credits	881.82

[1] In the account book the items for "Charges" will occupy the entire left-hand page, and those for "Credits" the entire right-hand page.

Now, suppose that on a trip to town on June 1 one spends $1.40 for horseshoeing, $3 for fencing, $5 for cow feed, and receives a $65 check for 6,500 pounds of milk. The entries are made as follows: The account marked "Horses" is turned to and on the left-hand page is entered "June 1—Shoeing, $1.40." The "Real estate" account is turned to and on the left-hand page is entered, "June 1—Fencing bought, $3." The "Cows" account is turned to and on the left-hand page is entered, "June 1—Cow feed bought, $5." On the right-hand page, under this same account, is credited, "June 1—Milk, 6,500 pounds, $65."

These entries are now complete; they will never have to be posted or entered again in any way. It is often advisable to keep a memorandum book in the pocket in which to make notes when money is paid out in town, so that the items will not be forgotten before they can be entered in the account book.

Whenever money is paid out, the farmer turns to the account in the book to which this money should be charged and enters it on the left-hand page. Whenever money is received the amount is credited to the proper account by entering it on the right-hand page under that heading. These are the only entries made. The amounts are charged or credited directly to the accounts to which they belong.

To find the account wanted is made much easier by indexing the books in the following manner: Take a piece of adhesive tape about 1½ inches long, bend it double, and stick it on the edge of the page in such a manner that it projects about one-half inch. On this projection write the name of the account kept on that page. Put a piece of tape on each account, arranging them one below the other along the edge of the book so that all can be seen at the same time. Tabs suitable for this purpose can be purchased from most stationers.

WORK RECORD.

For the work record, a book ruled exactly like the financial record book, except that there should be two double columns at the right of the page, may be used. This should be indexed in the manner already described. In this book no separate pages are used for charges and credits and no entries are made in terms of dollars and cents. In the first double column at the right-hand side of the page are entered man hours and minutes, and in the second are written horse hours and minutes. These headings should be placed at the top of each column, so that the page appears as shown in Table III. This book contains simply a record of the work done on the farm during the year, classified according to the enterprise for which it was done, and it also gives the date and number of hours of each operation.

The sample record with wheat shown as Table III will serve to illustrate the way the items should appear in the work record.

TABLE III.—*A sample work record with wheat.*

1912.	Operation.	Man.		Horse.[1]	
		Hours.	Minutes.	Hours.	Minutes.
Aug. 2	Plowing oats stubble	8	30	17	....
	Rolling	1	45	3	30

[1] Horse hours are expressed in terms of one horse for one hour. Hours of horse labor should not be charged against the horse account.

Suppose that the date is May 1. The work done on this day aside from chores was drilling in oats 6 hours, with 2 horses; plowing for corn 8 hours, with 3 horses; repairing plow, 2 hours of man labor alone. The entries are made as follows: The "Oats" account is turned to, "May 1" written in the left-hand column, the single word "Drilling" written in the broad space in the middle of the page, and the figure "6" entered under man hours. Since 2 horses were used for 6 hours, the figure "12" should be entered under horse hours. In the same way, on turning to the "Corn" account, "May 1—Plowing, 8 [under man hours], 24 [under horse hours]" is entered. Turning to the "Machinery" account "May 1—Repairing plow, 2 [under man hours]" is entered. When this is done, the work entry for the day is complete; it will never have to be posted or written again. The original entry is the only entry made.

For chores a special page should be ruled for each month, as shown in Table IV.

TABLE IV.—*A sample heading for a page of an account book showing the special ruling required for entering chores.*[1]

1913.	Horses.		Cows.		Poultry.		Hogs.	
	Hours.	Minutes.	Hours.	Minutes.	Hours.	Minutes.	Hours.	Minutes.
May 1	2	20	4	15	....	30	1	10
2								
3								
4								
etc								

[1] If horses are used in the chore work, extra columns must be ruled under each heading to provide a place for the entry of hours and minutes of horse labor.

It is more accurate to enter the chores every day; but, if chore time is fairly uniform each day, so that the chore work for the entire month can be based on fewer entries, an entry at the beginning, at the middle, and at the end of the month will ordinarily be sufficient. Entries should be made at other times if the time spent on chores changes; for instance, when the cows are turned to pasture, when additional cows freshen, or when a change of feed is made which will require more time or less time for chore work.

DAILY WORK NECESSARY TO KEEP A COMPLETE SET OF ACCOUNTS.

The daily work of keeping a complete set of accounts ordinarily consists in entering receipts and expenses for that day and recording the hours of work done. On many days there are no cash receipts or expenses, as these are likely to be bunched on the days when trips are made to town. An actual day's entry made by one of the cooperators was as follows:

1912.	Item.	Man hours.	Horse hours.
July 5	Cultivating corn	6	12
	Cutting hay	4	8
	Unloading hay	1	1
	Eggs, 35 dozen at 22 cents		$7.70
	Pulverizer repaired		.75
	Fork bought		.60

The entry of these items with the filling of the chore blanks for that day, if necessary, should not take more than five minutes. It is being done in less than an average of five minutes every day by 51 New York farmers, whose education varies from that acquired in a district school to that of the college graduate, all of whom are working every day in the field with their hired men.

CLASSIFICATION OF FARM PRODUCTS AND FEED.

Entries of the value of all home-grown feeds consumed must be made in the live-stock accounts. All the feed bought is charged in the financial record book directly against the animals for which it was bought. If the hog feed were to run out some day and a bag of cow feed were taken to the hogs, the entries should be made in the financial record book just as if the cows had sold this feed and the hogs had bought it.

At the time of thrashing or at the close of haying the total crop may be entered as a memorandum on the credit side of the proper crop account, but the figures are not yet to be carried to the money column. Estimates can be made with fair accuracy by measuring bins and haymows or by counting the loads drawn and estimating the average weight. The values will be entered when the product is sold or transferred to the animals. When these crops are fed out, an estimate must be made of the proportion fed to cows, horses, and other stock and these accounts charged with the values thereof, credit being given the crops. The quantity sold will be known from weighing bills or otherwise, and it should be credited as a cash receipt.

Whenever grain or hay is fed from the same bin or mow to two or more classes of animals, a day's ration for each class of animals may be weighed or measured once a month or oftener and the proper proportion of the total feed, based on these weighings and the number of days fed, charged to each class of stock. This method will give a reasonable degree of accuracy if weights are taken fairly often. When cows and horses are fed from separate haymows, there will be no difficulty in keeping the feed separate. Where concentrates are purchased in large quantities and fed to several classes of animals, a record may be kept in the feed room of the number of sacks fed to each class of animals.

CLASSIFICATION OF TROUBLESOME ITEMS.

The entry of some items will be confusing to the beginner. Generally common sense will straighten him out if he will ask himself "What account really deserves this credit?" or "What account really deserves this charge?"

The real estate and the machinery accounts usually puzzle the beginner in keeping farm records. The former is more or less of a general account in this financial book and work record. All items for fencing, ditching, improvements, repair of buildings, removal of old fences, new buildings, taxes, and insurance should be charged to this account. Many of these are somewhat permanent and are charges which the landlord ordinarily pays on farms leased on share rental. This account should be credited with any receipts from land rented out, old buildings sold, stone sold, and other similar items. If any special improvement is made, such as when a line of tile is laid, a building put up, or a silo built, one may open a separate account with it, if so desired. When complete, the cost should be figured and this amount charged against the real-estate account as an improvement.

Against the machinery account all costs of repairs to machinery and tools, all harness items, and the purchase of new implements or tools should be charged. This account should be credited with all receipts from sales of old machinery or machinery rented to neighbors. Under the work on machinery will be entered "Getting new plow points," "Repairing roller," "Storing away machinery," "Making new whiffletrees," and other similar items.

Such work as manuring may be charged against the crop to which it is applied, or an account may be kept with manure and the total cost of manure, including the cost of hauling, may be distributed to the different crops at the end of the year.

In this system no account is kept with "General expense." Nearly all items of this kind can be distributed as they occur. For instance, if a telephone is kept for the purpose of directing the hired man, the expense is charged direct to the labor account. If the telephone is kept for personal and general farm use, it may be charged partly to the personal and partly to the real-estate account. Such items as postage stamps, if small, may be charged to the farm account, but if a large number are used for one enterprise some of the purchases may be charged to this one enterprise.

It is nearly always possible to scatter the charges to different accounts as they occur. A general-expense account, if found to be necessary, should be kept very small.

MISCELLANEOUS NOTES.

There are many miscellaneous notes which it is desirable to keep in the same books with the accounts. Following are some of the entries which have been inserted by farmers and which are especially handy for later use. Sometimes they are merely written on the page where they seem to belong; at other times they are kept by themselves in the back of the book: Date of "last killing frost in spring;" date of "first killing frost in fall;" date of "death of [horse or cow];" "height of hay [or ensilage]" at a certain date.

Other miscellaneous records may be kept, such as herd records, maps of ditches, and maps of the farm, showing the crops for each year. These are not necessary in connection with the cost accounting, but may be kept if the farmer desires, and they will often prove useful.

CLOSING THE ACCOUNTS AT THE END OF THE YEAR.

Considerable time is required to close the set of accounts. However, this figuring should come in the winter at a time when other work is usually slack and when the weather is more favorable for working indoors than out. A definite order should be adhered to in closing the accounts. This order may be as follows:

(1) The first step is to take a final inventory in the same manner as at the beginning of the year. This inventory should include all bills that other persons owe the farmer and all bills which the farmer owes to other persons.

(2) The list of bills payable should be inspected and any items that have not yet been charged should be charged to the proper accounts. For instance, if $15 for labor is still due the hired man at the date of closing, this item should be entered as a charge against labor.

(3) The list of bills receivable should be inspected, and any items that have not yet been credited should be credited to the proper accounts. For instance, if the creamery owes the farmer $65 for milk and a neighbor owes him for some feed, the $65 should be entered as a credit to the cow account and the feed item entered as a credit to the account from which the feed was originally taken.

(4) The record of all feed transferred to the live stock should be completed, charging the various animals and crediting the various crops. Produce raised and fed is charged against the animals at what it is worth on the farm. Suppose, for instance, there were 80 acres of hay with a total yield of 120 tons (20 tons of which had been sold and a credit entered) and that the feed-disposal memorandum showed 60 tons fed to the cows and 15 tons fed to the horses, leaving 25 tons on hand. If hay is worth $12 per ton at the barn, the hay should be credited by entering on the right-hand page of the hay account "60 tons to cows @ $12=$720; 15 tons to horses @ $12=$180." Now, charges against the cows "60 tons of hay @ $12" and against the horses "15 tons @ $12" should be made. When the value of the hay on hand, 25 tons at $12, as shown in the record inventory, is entered as a credit to the hay account, the credits to this account will be complete.

(5) The various classes of live stock should be credited with the portion of unused feeds which were charged to them at the time of purchase or harvest. These farm items will, of course, appear in the second inventory under the group headed "Feeds, produce, and supplies."

(6) The use of pasture should be credited directly to the real estate or to a pasture account and charged against the animals using it. The amount charged for pasture should be as nearly as possible the market price; that is, the price for which pasture rents in that region.

(7) The value of produce used in the house, if not noted before, should be entered. The proper crops or animals should be credited and charges made against the personal account. This item includes estimates of the quantities of milk, eggs, potatoes, and other products used by the family.

(8) The entry of value of board, produce, or other allowances furnished to the laborers should be completed. These charges should be made against labor and the proper accounts credited.

(9) The value of unpaid labor, such as work by the farmer himself, by boys in the family to whom regular wages are not paid, and milking or other farm work by women of the family should be entered. Make these charges against labor and credit the personal account.

(10) The animals should be credited with the value of the manure produced and this amount charged against the crops to which it was applied. The valuation of the

manure should be made at about the market price at the farm. To find the quantity produced, a record should be kept of the number of loads hauled to the fields.

(11) The proper amounts for the use of the buildings by crops, animals, the farmer, or laborers, should be entered. Each crop, each class of animals, the personal account, and the labor account should be charged with its proper proportion and credit of the real-estate account. As a general rule, 8 to 10 per cent of the current value of the buildings may be charged as rent. The proportion of the whole sum which each class of animals or each crop should pay will have to be determined by the farmer in proportion to the amount and value of the space occupied by each. Charges for the use of the buildings on one farm were made as follows:

[Value of barns, $2,000; use for one year at 10 per cent, $200.]

Account to be charged.	Percentage of $200.	Amount.	Account to be charged.	Percentage of $200.	Amount.
Cows	30	$60.00	Horses	20	$40.00
Hay	20	40.00	Corn	5	10.00
Oats	10	20.00			
Machinery	10	20.00	Total	100	200.00
Hogs	5	10.00			

(12) Taxes and insurance paid on personal property should be distributed to the proper accounts. All land taxes are charged to the real estate account and distributed as part of the "Use of land and buildings."

(13) All the hours and minutes of man labor on each enterprise, including the chores, should be added up, these totals being brought together and the sum of the man hours on all enterprises found.

(14) The total cost of man labor for the year should be found.

(15) The rate per hour should be found by dividing the total cost of man labor by the total hours of man labor.

(16) The total number of hours found against each enterprise in the work record should be transferred to the same accounts in the financial record, multiplying each total by the rate to obtain the cost. These items should be credited to labor in the financial record book. When this is completed, the labor account should balance within a few dollars, though if the rate per hour were carried out in full to the last decimal place the account would balance. A difference of 1 mill in the rate for 6,000 hours would make a difference of $6 in the final results, and a difference of one-tenth of a mill would make a difference of 60 cents. This difference or error is not important enough to consider. It may be carried to the "Loss and gain" account, or it may be added to or subtracted from one of the larger items of labor, in accordance with whether it is a loss or a gain.

(17) All the hours and minutes of horse labor spent on each enterprise, including any horse labor on chores, should be added up, these totals being brought together and the sum of the horse hours on all enterprises found, just as was done for man labor.

(18) To find the total cost of horse labor, first the horse inventories should be entered, the first inventory as a charge and the second as a credit to the horses. Then the horses should be charged with interest on the average of the two inventories at the current rate in the section and the interest account credited. The ordinary rate charged in most parts of the United States is 5 or 6 per cent on the investment.

(19) The sum of each side of the horse account should be found. The sum of the credits should be subtracted from the sum of the charges and the difference will be the net cost of horse labor for the year. No charge is made against horses for the use of the harness and other horse equipment, all these costs being charged against the various enterprises in the machinery charge, as hereafter explained, on the basis of horse hours.

(20) The rate per hour of horse labor should be found by dividing the total cost by the total hours. The figure thus obtained is the rate per hour.

(21) The total number of horse hours found against each enterprise in the work record should be transferred to the same accounts in the financial record, multiplying each total by the rate to obtain the cost. These items should be credited to the horse account in the financial record book. When this is completed, the horse account should balance within a few dollars. The reason for the failure to balance is the same as that already given for man labor. To make the account balance, the difference can be added to or subtracted from one of the larger items or carried to the "Loss and gain" account, as stated in paragraph 16.

(22) To find the use cost of the machinery, the first machinery inventory should be entered as a charge and the second as a credit to the machinery account, then this account should be charged with interest on the average of the two inventories, as directed for the horse account. The interest account should be credited with the amount of this interest.

(23) The sum of each side of the machinery account should be found and the credit total subtracted from the charge total, the same as for the horse account. The difference is the total use cost of the machinery for the year.

(24) In order to distribute this cost, it may be assumed that for every hour horses were worked machinery was also used. Then each account will have charged against it the same number of machinery hours as horse hours. To find the rate of cost per machinery hour, the horse hours already charged to machinery should be first subtracted from the total hours of horse labor and the total cost of machinery use divided by this difference. Now the use of machinery for the year should be charged in the same way that the use of horses was charged, except the charge against machinery. When this is complete, the machinery account should balance within a few dollars. The difference may be treated as explained in paragraph 16.

(25) Any other accounts of convenience, such as those for fertilizer or manure, if kept, should be distributed.

(26) All the remaining items should be entered in the inventories. The inventory values for the beginning of the year should be entered on the left-hand page of the separate accounts as a charge; that is, the cow inventory should be entered on the left-hand page of the cow account, the hog inventory on the left-hand page of the hog account, and the others distributed in the same manner. The final inventory for the year is likewise distributed to the separate accounts, but the items are entered on their respective right-hand pages.

(27) The interest, based on the average inventories against all accounts not already charged, should be charged and the interest account credited with the total, using the same rate as that used in charging interest against the horse and machinery account.

(28) The proper charge for the use of the land should be entered. The rate should be high enough so that, with the use of buildings as charged in paragraph 11, it will cover interest on the investment in land and buildings, taxes on real estate, and repairs to buildings and fences, for these items were charged to the real-estate account. Each crop should be charged for the land it occupied and the real-estate account credited.

(29) Both sides of the accounts not yet closed should be footed up. The lesser total should be subtracted from the greater in each account. If the charge side is greater the difference represents a loss, and if the credit side be greater, a gain. The sample potato account given in Table II (p. 6) will illustrate a completed crop account.

(30) A list of the losses and gains should be made and the total of each found in order to show the net gain or loss on the whole business.

(31) Each account and the business as a whole should be studied in order to learn how to improve it.

STUDY AND INTERPRETATION OF RESULTS.

Farm accounts are of little use unless studied and conclusions drawn which will enable one to make his business more profitable in the future. It is just as important to study the different items of cost and returns in an account as it is to know whether or not it pays. From such a study it is often possible to learn how to reduce the cost of production or increase the returns so as to make a losing enterprise pay and to make a profitable one more profitable. In studying the results of a year's business, one must keep constantly in mind that these are the results of a single year. Weather conditions, crop conditions, market conditions for the year as compared with an average year, must be considered. For instance, potatoes in 1912 showed large losses on many farms because of the low prices and the quantities lost by rot. However, by studying the potato account to find the cost of producing an acre, then, by considering both an average yield and price for the locality, one could draw the conclusion that ordinarily it would or would not be a profitable business to raise potatoes on most of the farms where potatoes are raised.

The potato account in Table II (p. 6) was studied when it was closed, and the following facts were obtained: Total acreage, 14; total yield, 1,128 bushels; yield per acre, 80.6 bushels; total cost of crop, $469.20; cost per acre, $33.51; total value of crop, $857.82; value per acre, $61.27; total profit, $388.62; profit per acre, $27.76; man hours per acre, 57; horse hours per acre, 60; labor cost per acre, $10.81; horse labor cost per acre, $6.27; cost per bushel, 41.6 cents; profit per bushel, 34.4 cents. The average value per bushel was higher than is ordinarily received for market potatoes.

Besides the satisfaction of actually knowing what crops or enterprises paid and how much, there are many other ways in which the accounts may be useful. They may be used to study the seasonal distribution of labor on the farm as a whole and on separate enterprises, and also to determine what crops and what animals are the most profitable. By comparing one's results with the facts detailed in bulletins on the same subject, one can find how his efforts compare with those of other farmers as to economy of labor, the working efficiency of horses, and many other points.

By keeping farm cost accounts one can not help but gain an idea of the value of labor. He soon finds that time represents money and that it is equally as important to save one as the other. He sees that it is just as important to save an hour's work by man and team on an acre of oats as it is to get a yield of an extra bushel per acre and that it is more wasteful to have a team idle than to have one man idle for the same length of time.

Farm cost accounts will help to teach one that very often the largest yields may not pay. After closing the accounts the farmer usually gets many surprises. Often he finds that the enterprises which he thinks are the best and to which he devotes most of his time are being conducted at a loss, while the steadier, more common enterprises or crops may be the only ones that show profits.

The system of farm cost accounting outlined in the foregoing pages is not a theoretical system, but one which for several years, with many types of farming and under widely differing conditions, has given satisfaction. It is hoped that what has been written will furnish helpful suggestions to farmers who are keeping accounts and are not satisfied with the results obtained from their present system, and that it will be a guide to be followed by many others who wish to keep accounts but have not known how to make a beginning.

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A SYSTEM OF FARM COST ACCOUNTING

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Revised by

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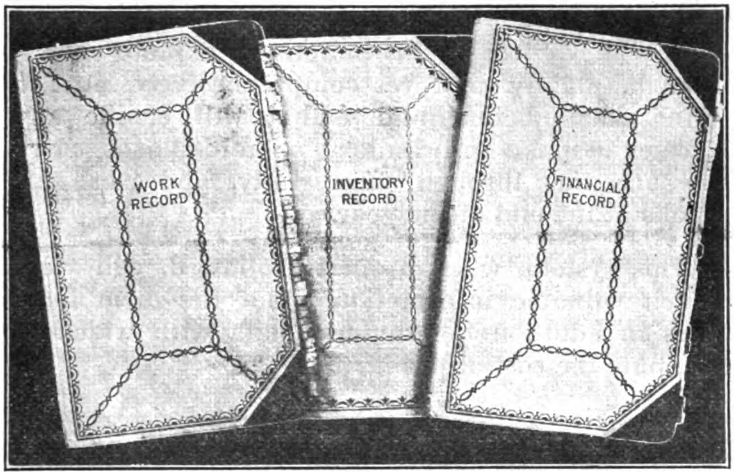

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H. C. TAYLOR, Chief

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THE INCREASED interest in cost of production of farm products has stimulated the demand for systems of farm cost accounting, and especially for a system that is simple in application and planned to give the farmer the information he requires without going into the complexity of detail involved in a highly technical system.

It is the object of this bulletin to explain such a system, plainly, and yet comprehensively, and to offer detailed information that will enable any farmer to make an inventory, open his books, carry his accounts through successfully, and close his books at the end of the year.

This system, when properly followed, will yield much valuable information about the farm business in addition to providing data with which to estimate the cost of production.

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A SYSTEM OF FARM COST ACCOUNTING

C. E. LADD, *Agent*
Revised by JAMES S. BALL, *Assistant in Farm Accounting*

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THE BUSINESS FARMER wishes to know how much he is making or losing on his business each year, how much he is making or losing on each crop or class of animals, and how he can improve his business so as to make more money. The function of farm-cost accounting is to supply this information. Cost accounting for the farm is the same sort of work large manufacturing companies do to learn whether they are making a profit on their different products. The farmer wants to know whether his wheat pays, whether his cows pay, or his orchard. These are some of the questions a set of farm cost accounts will settle.

Many farmers are desirous of keeping accounts of this sort but do not know how to start. Undoubtedly many are deterred from starting because they believe they do not know enough about bookkeeping and because they have in mind no definite method of procedure. To any such men who desire to keep accounts and who have not worked out a system for themselves, it is believed that the system outlined in this bulletin will be helpful. Those who are already keeping accounts but are not satisfied with the results obtained may find here some suggestions of value.

NOTE.—This System of Farm Cost Accounting was developed by Prof. G. F. Warren, of the New York State College of Agriculture, on his own farm, where it has been used for 12 years. The principles of the system are outlined in his book entitled, "Farm Management." It has been given a thorough trial for 8 years with a number of farmers under the immediate supervision of Mr. Ladd and others, working jointly for the U. S. Department of Agriculture and the New York College of Agriculture, and has given excellent satisfaction and valuable results.

DEC

No cost accounting can be absolutely exact. Commercial cost accounting and farm cost accounting are alike in this respect. Both are based partly on estimates and partly on ascertainable facts, and both approach exactitude in proportion to the accuracy of these estimates. It is therefore important to make the most accurate estimates possible rather than be satisfied with rough approximations. As the work is carried on year by year and experience is gained, greater accuracy in estimating is attained, with correspondingly greater accuracy in the results of the cost accounts.

On the other hand it is not wise to spend much time with refinements in methods of bookkeeping that are designed to check to the last cent. In fact, attempts to find insignificant errors often disgust inexperienced persons with the whole question of accounting.

Of the desirability of keeping records on a farm much has been written in the agricultural press. In an agricultural survey of Tompkins County, N. Y., made in 1907, it was found that 45 per cent of the farmers already kept some sort of records and accounts, and the proportion has undoubtedly increased since that time.

This bulletin aims to give a description of a system of farm accounting which has been tried for eight years in the State of New York with a number of farmers under widely differing conditions and has proved fairly successful. It is aimed herein to outline the practical working of the system in sufficient detail so that any one who wishes may start it without further aid. It is a method simple enough, when the necessary complexity of any cost accounting is considered, and many farmers should be able to keep the accounts without assistance.

This is a "direct-entry" system, in that there are no preliminary books in which the original entries are to be made and from which they are to the "posted" or copied to the permanent accounts. This feature, which would be a serious fault in commercial accounting, where a hired bookkeeper is employed, as it would be impossible to check or audit the records, is a valuable one for the farmer who keeps his own books, in that it does away with that great bugbear, "posting," resulting in the saving of much time. It is, however, often advisable in busy seasons, when time will not permit the entries to be made each day, to keep a pocket memorandum book in which to make notes from day to day so that nothing is forgotten or overlooked.

TIME REQUIRED TO KEEP ACCOUNTS

The first question the practical farmer asks about a proposed set of accounts is "How much time will it take?" The time required is one of the chief objections made to farm cost accounting, but farmers who have used this particular system during the past eight years answer the question of time by estimates ranging from two to ten minutes per day. The average seems to be about five minutes for the daily entries. To this must be added a number of hours' work, or perhaps a day or two, at the end of the year to close the year's accounts and open the books for the new year. This time will vary with the type of farming, the complexity of the business, and the degree of accuracy and completeness with which the accounts have been kept.

The daily work of keeping this set of accounts ordinarily consists in entering the receipts and expenditures for the day and recording the hours of work done. On many days there are no cash receipts and expenditures, as these are likely to be bunched on the days when trips are made to town. As a sample an actual day's entries made by one farmer is given as follows:

1918.	Items.	Man hours.	Horse hours.
July 23.	Cultivating corn	5	10
	Cutting hay	3	6
	Making hay	2	2
	Sold eggs, 5 dozen at 45 cents		$2.25
	Paid veterinary for visit to horse	$3.00	
	Paid extra hand, 5 days at $3	15.00	

The entry of these items to the proper accounts, with the filling of the chore blanks, if necessary, should not take more than five minutes. It is being done in less than an average of five minutes per day by a number of New York farmers whose education varies from that acquired at a district school to that of the college graduate, all of whom are working every day in the field with their hired men.

BOOKKEEPING KNOWLEDGE UNNECESSARY

No bookkeeping knowledge is necessary for the successful keeping of this system. In the work done so far, bookkeeping training, as sometimes given in commercial schools, has seemed in some instances rather a detriment than a help, although this training aids in grasping accounting principles. Those trained in commercial bookkeeping have a tendency to lean toward bookkeeping technique and complexity of entry, which are out of place for a working farmer who wishes to do cost accounting. It is not necessary to know a day book from a journal or to know how to prepare a balance sheet in order to keep farm cost accounts.

A FAVORABLE TIME TO START ACCOUNTS

Accounts may be started any time after the last crop is harvested in the fall and before the first crop operations are started in the spring. They should be started on the first day of some month, but the exact date will depend upon the geographical location of the farm and the nature of the business or type of farming in practice. The time should be as late as possible in order that there may be the smallest quantities of last year's crops on hand to be inventoried. However, the date should be early enough to allow sufficient time to close the year's accounts, work out results, plan the next year's business, and open the new accounts before the spring crop work begins. In a large majority of cases the best date will fall between January 1 and April 1. For a tenant the date of taking an inventory and opening the accounts will, of course, correspond to the date of his lease.

REQUIREMENTS FOR KEEPING A COMPLETE SET OF FARM COST ACCOUNTS

In order to have a complete set of farm-cost accounts four classes of records are necessary.

1. An inventory at the beginning and end of the year.
2. An account of all money paid out or received, and of all purchases or sales on credit.
3. A record of feeds consumed, crop supplies used, and crop yields.
4. A record of all work done by men, horses, tractor, or other power during the year.

In this system of accounts these four classes of records are carried in the three books illustrated on the cover of this bulletin, known as the Inventory Record, Financial Record, and Work Record. In the second book all entries are made of class 3 as well as the cash items of class 2.

INVENTORY RECORD

To make an inventory on an ordinary farm is a matter requiring from two to five hours work at the beginning of each year. The same inventory is used for closing the accounts of one year and opening those of the next. The inventory should be a detailed list, with values of all the farm property and farm debts, and should include:

1. The farm, subdivided into buildings and land (each building being listed separately), giving the number of acres of land and its value per acre. The total value of the land and buildings listed should equal the value of the whole farm. Where there is land of greatly differing values the list should show acreage and value per acre of each kind.
2. The horses, listed by name.
3. The other classes of live stock listed separately, giving value per head.
4. Machinery and tools, each item being listed separately, except that the very small and cheap tools may be listed as one item.
5. Feed, produce, and supplies, giving both quantities and values.
6. Growing crops (value of labor and materials already spent for next year's crops).
7. Cash on hand and in bank.
8. Accounts receivable or amounts owing to the farm for goods sold or services rendered on credit.

The foregoing are known as the "assets" of the business, and the grand total of them all should be found. From this grand total should be subtracted the total of the "liabilities" of the business, which would include the mortgage, if there is one, any notes owed to the bank or others, and all bills which may be owing for goods purchased on credit.

In estimating values, the market price *at the farm*, or price at the market point less the cost of hauling and shipping to market, should be the standard for all marketable produce and live stock; other assets, such as machinery, buildings, and any items of like nature, should receive the "going-concern" value. By "going concern" value is meant what they are worth to the farm as a going business. The value put upon any item should be what it is thought can be obtained for it at normal sale and should neither be overrated nor underrated. It is best to be fair and conservative and to use good judgment in placing values. Value all purchased supplies at cost.

TABLE I.—*Sample of an inventory*

Farm:			
Land:			
Crop land, 92.62 acres, at $96		$8,891.52	
Woods, 22.60 acres, at $40		904.00	
Apple orchard (30 years), 3.83 acres, at $300		1,149.00	
Total land, 119.05 acres			$10,944.52
Buildings:			
Dwelling, 35 by 50, built 1884, cost $3,000		2,500.00	
Tenant house, 35 by 25, built 1864, cost $1,000		788.00	
Barn, 90 by 20, built 1870, cost $3,500		2,900.00	
Hen house, 12 by 90, built 1908, cost $200		178.00	
Total buildings			6,366.00
Total value of farm			17,310.52
Live stock:			
Horses:			
Nell, bay mare, born 1907, cost $250		170.00	
Bell, gray mare, born 1907, cost $250		170.00	
Tom, brown gelding, born 1904, cost $275		110.00	
Dick, chestnut gelding, born 1906, cost $250		120.00	
Total horses (4)		570.00	
Cattle:			
Cows (2), at $75	$150		
Heifer	50		
Total cattle		200.00	
Swine:			
Brood sows (7)	300		
Boar	50		
Hogs (29)	545		
Total swine		895.00	
Poultry:			
Hens and roosters (50)		60.00	
Total value of live stock			1,725.00

Machinery and tools:	Size.	Year bought.	First cost.	No.	Present value.
Plows, walking	12 in.	1912	$12	2	$7
Disk, double	6 ft.	1913	28	1	18
Binder, grain	6 ft.	1911	128	1	55

and so on through list of machines owned.

Total value machinery and tools (including items omitted here)			$1,196.25
Farm produce:			
Corn, 50 bushels of ears, at $0.90		$45.00	
Hay, 32 tons, at $20		640.00	
Straw, 2½ tons, at $5		12.50	
Total value of farm produce			697.50
Feed and supplies:			
Bran, 500 pounds, at 2¾ cents		13.75	
Tankage, 1,600 pounds, at 4 cents		64.00	
Lime, 4 bags, at 40 cents		1.60	
Seed oats, 40 bushels, at 64 cents		25.60	
Cement, 2 bags, at 50 cents		1.00	
Total value of feed and supplies			105.95
Growing crops:			
Wheat field B—			
72 hours of man labor, at 30 cents		21.60	
225 hours of horse labor, at 12 cents		27.00	
26 bushels seed wheat, at $2.50		65.00	
1 ton fertilizer, at $34		34.00	
Total value of growing crops			147.60
Account receivable, for 1 cow			70.00
Cash on hand and in bank			252.04
Total value of assets (or property owned)			21,504.86
Farm mortgage (interest due Jan. 1 and July 1)		9,250.00	
Note at bank, due Apr. 18		250.00	
Accounts payable:			
For thrashing bill	$29.76		
For labor	16.11		
On cattle	85.00		
		130.87	
Total "liabilities" (or values owed others)			9,630.87

SUMMARY.

Total value assets	21,504.86
Total liabilities	9,630.87
Present net worth	11,873.99
Net worth one year ago	10,976.50
Gain in net worth	897.49

Table I is presented here as a suggestion as to the way in which the inventory items appear when classified and grouped according to the foregoing schedule, and also illustrates how the net worth is determined and the gain or loss in net property value during the year is set forth.

Figure 1 illustrates how the entries appear in the Inventory Record. It is best to put only one class of property on each page so as to allow for expansion in number in the years to come. It is also shown in this figure how, by trimming intermediate pages, a single series of certain property item entries may serve for many years by extending the money value of each item to the next succeeding column on each subsequent inventory date. This is a feature of the book that saves much clerical work at inventory time.

No other account will give so valuable information for the time and labor expended as the annual inventory. By comparing the net worth as shown by the current inventory with the net worth of previous years, the farmer can determine whether his business is progressing or going backward.

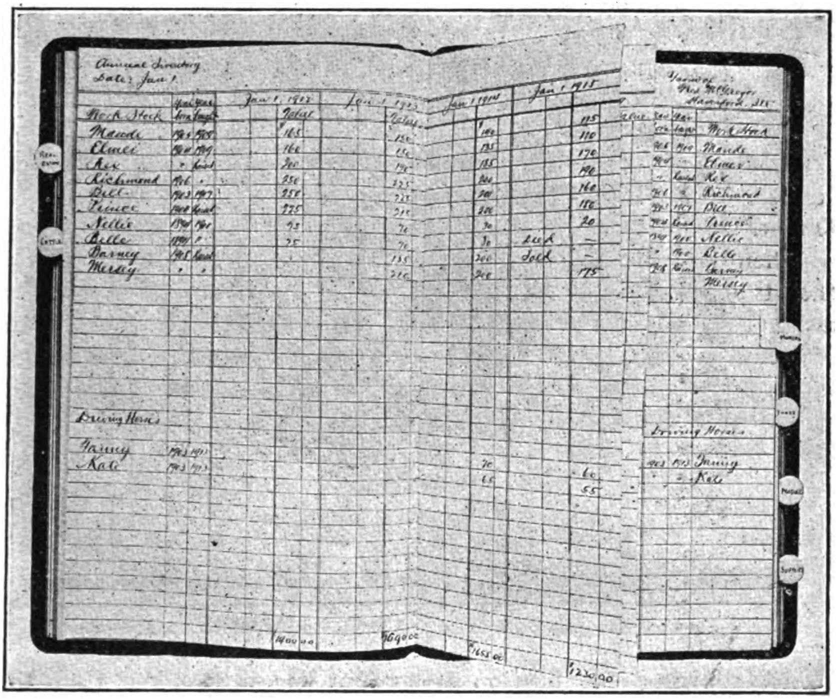

FIG. 1.—Showing how the entries are made in the inventory record.

FINANCIAL, FEED, AND CROP RECORD

For this record, referred to in this bulletin as the Financial Record, a book called by stationers a "broad day-book" or "journal" is used. The requirements are that there be a place for a date on the left-hand side of the page, a broad space in the middle of the page in which to write explanations, and columns ruled for dollars and cents at the right. Two pages facing each other are taken for each account. The name of the account is written at the top of the pages. The right-hand page is marked "Credits" and is used only to record credits to the account. The left-hand page is marked "Charges" and is used only for charges against the account. Figure 2 gives a good idea of how the pages are ruled and the manner in which the entries are made in this record. At the end of the year this book becomes the completed account book, as to it at that time are entered the items from the other two record books as described later.

A separate account is kept with real estate, each crop grown, each class of animals, machinery, labor, interest, each person dealt with on credit, and such other headings as may be found necessary or convenient.

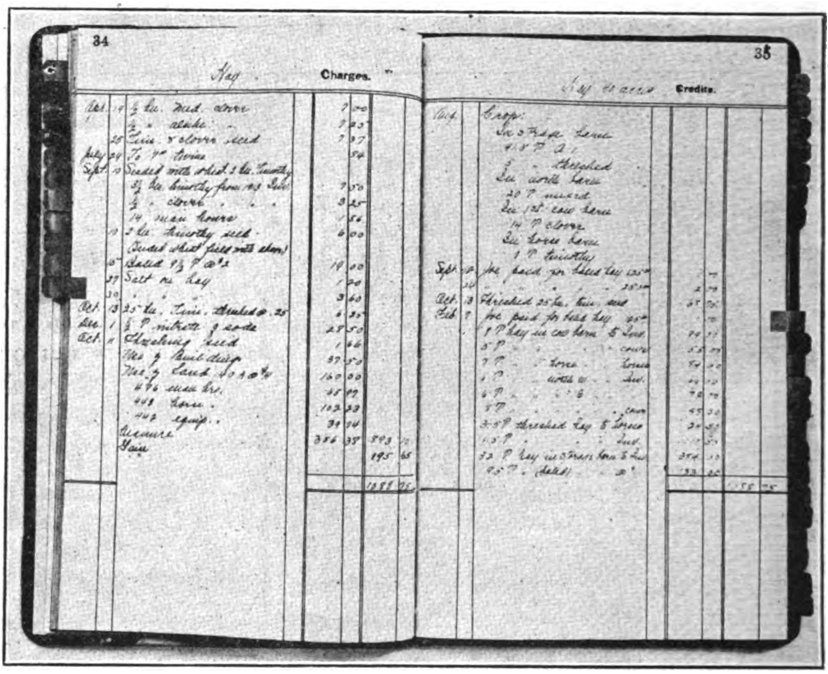
34
Hay
Charges.
35
Hay Acres
Credits.

FIG. 2.—Showing how pages are ruled and entries made in the financial record.

The following classification of account headings, taken from the account book of a New York farmer, will give some idea of the number and kind of accounts it may be necessary to keep:

Crop accounts:
- Corn.
- Oats.
- Peas.
- Hay.
- Potatoes.
- Orchard.
- Buckwheat.
- Rye.
- Wheat.

Live stock accounts:
- Cows.
- Hogs.
- Poultry.
- Pasture.

Labor accounts:
- Man labor.
- Horses.
- Equipment.
- Tractor.

General accounts:
- Real estate.
- Feed and supplies.
- Interest.
- Manure.
- Loss and gain.
- Personal.

Next year crops:
- Wheat, etc.

In addition to the foregoing were the accounts with each firm or person with whom dealings were had on credit.

HOW THE ENTRIES ARE MADE

At the end of each day, if time permits, all money received or paid out since the last entries were made should be entered in the various accounts, *crediting* all money received and *charging* all money paid out. For instance, if on a trip to town on June 1, $1.40 is spent for horseshoeing, $3 for fencing, $5 for cow feed, and a $65 check received for 200 gallons of milk, the entries are made as follows: The account marked "Horses" is found, and on the left-hand page, headed "Charges," is entered "June 1, Shoeing, $1.40." The "Real estate" account is then found, and on the left-hand page is entered "June 1, Fencing, $3." The "Cows" account is next found, and at the left is entered "Cow feed bought, $5," while on the right-hand page, under "Credits," is entered, "June 1, Milk, 200 gals., $65." These entries are now complete. They will never have to be "posted" or entered again in any way.

INDEXING

Finding the account wanted is made easier by indexing the books in the following manner: A piece of adhesive tape about 1½ inches long is bent double and stuck on the edge of the page in such a manner that it projects about a half inch. On this projection is written the name of the account kept on that page. A piece of tape is put on each account, arranged one below the other along the edge of the book so that all may be seen at the same time. Figure 2 illustrates how these tapes appear when properly placed. Prepared paper tabs, suitable for this purpose, can be purchased from most stationers. (See fig. 1.)

FEED AND CROP ENTRIES

All feed bought is charged as purchased directly against the accounts of the animals for which it was secured, the same as any other cash item. If the hog feed should run out some day and a bag of cow feed taken for the hogs, the entries should be made in the record book just as if the cows had sold this feed and the hogs had bought it.

The value of all home-grown feeds consumed must be charged to the live-stock accounts and credited to the crop producing them. This can be done at convenient stated periods, as each week or each month. As home-grown crops are fed out an estimate must be made of the quantities fed to horses, cows, and other stock, and these accounts charged with the values thereof, credit being given the crop accounts. A day's rations may be weighed or estimated once a month or oftener and the proper proportion of the total feed consumed, based on these weighings and the number of days fed, may then be duly charged and credited. This method will give a reasonable degree of accuracy if weights are taken fairly often. When the different classes of animals are fed from separate grain bins and haymows there will be no difficulty in keeping the feed accounts separate, if a record is kept of the quantities put in each at harvest time and sold out from each thereafter.

Where concentrates are purchased in large quantities to be fed to several classes of animals the charge may be made to "Feed and supplies" account and a record kept in the feed room of the quantities fed to each class of animals. Proper charges can be made on the basis of this record and the "Feed and supplies" account credited.

At the time of thrashing or at the close of harvesting a crop, the total yield may be entered as a memorandum on the credit side of the proper crop account, but the values are not yet to be carried to the money column. Yields of hay, straw, etc., can be estimated with fair accuracy by measuring bins and haymows or by counting the number of loads drawn and estimating the actual weight. In all cases allowance for shrinkage should be made. The money values are to be entered as the crop is sold or transferred to the animals. Quantities sold will be known from the weighing bills or otherwise.

When barnyard manure is hauled out to the fields it should not at that time be charged directly to the crop accounts. A "Manure" account is provided to carry all manure charges until the end of the season. The entries in this account should give the crop to which applied, the kind of manure, the number of tons or loads hauled out each day, and the value. At the end of the year the manure account is closed by charging each crop account in a single item for its proportion of the total value of the manure applied thereon, together with the cost of applying, as explained hereafter. (See Table II for sample crop account.)

TABLE II.—*Sample account with potatoes*

Charges.			Credits.		
1918	Item.	Amount.	1918	Item.	Amount.
June 3	Seed, 160 bushels at $1	$160.00	Oct. 5	Sold 226 bushels at $1.05	$237.30
4	Corrosive sublimate, 3 ounces	.60	19	Sold 510 bushels at $1.15	586.50
10	Seed, 43¾ bushels at $1.10	48.13	Nov. 1	Sold 241 bushels at $1.25	301.25
11	Corrosive sublimate, 6 ounces	1.20			
July 12	Paris green, 6 pounds	3.00	Date of closing books.	Saved for seed 135 bushels at $1.00.	135.00
15	Lead arsenate, 160 pounds	25.60		Saved for home use, 16 bushel at 75 cents.	12.00
Date of closing books.	Use of land 5 per cent on $100 per acre.	70.00			
	Man labor, 796 hours at $0.282.	224.47			
	Horse labor, 839 hours at $0.1846.	154.88			
	Equipment use, 839 hours at $0.035.	29.36			
	Manure, 30 per cent of 1916 application.	6.00			
	Manure 40 per cent of 1917 application.	12.00			
	Total charges	735.24		Total credits	1,272.05
	Gain	536.81		Total charges	735.24
	Grand total	1,272.05		Gain	536.81

WORK RECORD

For the Work Record a book like the Financial Record book is used. There must be two double columns at the right of the page as shown in figure 3. This book should be indexed in the manner already described. In this book no separate pages are used for charges and credits and no entries made in terms of dollars and cents. In the first double column at the right-hand side of the page are entered hours and minutes of man labor, and in the second are entered hours and minutes of horse labor. These headings are placed at the top of each double column so that the book appears as shown in figure 3. This book is to receive simply a record of the work done on the farm during the year, classified according to the enterprise for which it was done, and it also gives the date and number of hours for each operation. Where a tractor is in use, the tractor hours may be carried in the narrow space immediately preceding the man-labor columns.

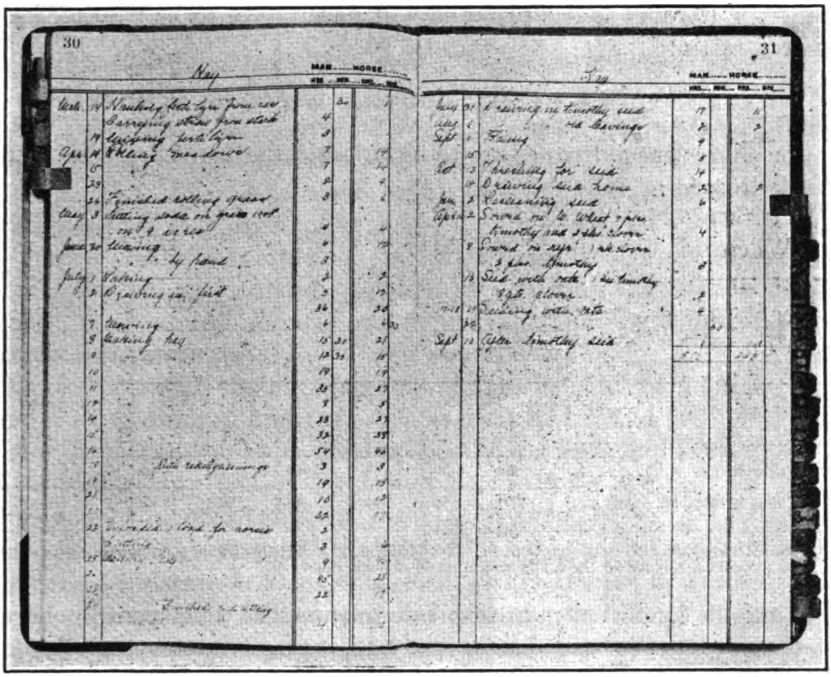

FIG. 3.—Showing how the pages are ruled and headed and the entries made in the work record.

HOW THE ENTRIES ARE MADE

The method of making entries in the Work Record will be understood from the following example: The date is May 1. The work done this day is, aside from chores, drilling oats 6 hours with two horses; plowing for corn 8 hours with three horses; repairing plow 2 hours. The entries are made as follows: The "Oats" account is found, "May 1" written in the left-hand column, the single word "Drilling" written in the broad space in the middle of the page, and the figure 6 entered under man-hours. Since 2 horses were used for 6 hours, the figure 12 should be entered under horse-hours. In the same way, on turning to the "Corn" account, "May 1, plowing 8 (under man-hours), 24 (under horse-hours)" is entered. Turning to the "Machinery" account, "May 1, repairing plow, 2 (under man-hours)" is entered. When this has been done the work entry for the day is complete; it will never have to be "posted" or written again.

METHOD OF RECORDING ROUTINE WORK OR "CHORES"

For chores special pages are to be ruled in the front or back of the Work Record as follows:

Routine work estimates

Date.	Horses.		Cows.		Poultry.		Hogs.	
	Hours.	Minutes.	Hours.	Minutes.	Hours.	Minutes.	Hours.	Minutes.
1918.								
May 1	2	20	4	15	....	30	1	10
May 15	2	40	5	5	1	....	1	30
Average for May	2	30	4	40	....	45	1	20
Total for May (31 days)	77	30	144	40	23	15	41	20

NOTE.—If horses are used in the chore work, extra columns must be ruled under each heading where they are used to provide a place for the hours and minutes of horse labor.

It may be somewhat more accurate to enter the time spent in chores every day, but, if chore time is fairly uniform, estimates made two or three times a month will be all that is required. If the time spent on chores changes greatly at any time, for instance when the cows are turned out on pasture in the spring, or when additional stock is purchased, entries should be made so that these changes may be taken into account. On the basis of the estimates of chore labor the total time for the month is figured under each heading. The monthly totals may be charged to the proper accounts once a month, or the total time for the year may be found and charged as a single item just before the books are closed at the end of the year. When any special work is done on live-stock accounts, as for instance when sick animals are cared for, it should be charged direct to the proper account, no attempt being made to allow for it in the chore estimates.

CLASSIFICATION OF TROUBLESOME ITEMS

The entry of some items may be confusing to the beginner. In most cases a little thought coupled with common sense will straighten him out if he will ask himself: "What account produced this value and therefore really deserves this credit?" or, "What account caused this expense and therefore really deserves this charge?"

The "Real estate," "Machinery," and "General expense" accounts usually puzzle the beginner in keeping farm records. All items of permanent improvement or repairs to buildings, fences, ditching, removal of old fences, new buildings, new fences, etc., as well as the insurance on buildings and the real estate taxes, are handled in the "Real estate" account. Many of these are the charges which the landlord usually pays on tenant farms. This account should be credited with receipts for land rented out, old buildings sold, stone or sand sold, and other similar items. Sometimes it may be desirable to open a separate subaccount under this general class when a special improvement is made, as a new silo or barn. When the improvement is completed, its net cost can be figured from this subaccount, which can then be closed by charging the improvement to the "Real estate" account as a single item and crediting the subaccount in like amount.

Against the "Machinery" account should be charged all costs for repairs to machinery and tools, all harness items, and the purchase of new implements or tools, getting them to the farm and setting them up, as well as any fuel or lubricants for the farm engine. This account should be credited when machinery is rented to neighbors or when old machines and junk are sold.

Where a separate account is carried with a tractor or automobile, all items pertaining to these special accounts should, of course, be charged or credited to them and not to the general "Machinery" account.

It is not desirable to keep an account with "General expense," as such an account has proved to be a troublesome one to distribute. Nearly all items can be distributed as they occur. For instance, in the case of telephone rentals, if the telephone is kept for both personal and farm purposes, the rental can be charged partly to "Personal" account and partly to those farm enterprises for which it is mostly used. Other general items, as postage, stationery, etc., can be handled in the same manner. It is nearly always possible to scatter the charges to different accounts as they occur and it saves time when closing the books at the end of the year. If a "General expense" account is found to be indispensable, it should be limited to the fewest possible items.

SUPPLEMENTARY NOTES

There are many supplementary notes which it is desirable to keep in the same books with the accounts. Sometimes they are written on the page of the special account to which they belong; at other times they are kept by themselves at the back of the book. Dates of "last killing frost in spring," "first killing frost in fall," "death of horse or cow," and "height of hay in mow or silage in silo at this [given] date" may be cited as valuable information that may be recorded in this way.

There are other records that may be kept if desired, such as herd records, maps of ditches, maps of the farm showing crops grown each year, and yearly crop records showing fertilizer or manure applied and yields each year. These are not necessary to the success of the cost accounting but are useful at times and may be kept in the back of one of the books if desired.

OPENING THE BOOKS AT THE BEGINNING OF THE YEAR

The opening of the books is not difficult if the inventory is complete and properly prepared. First, an account is opened in the Financial Record with each class of property as shown by the inventory, such as "Real estate," "Horses," "Cows," "Machinery," "Feed and supplies," and other accounts with property, and also with each individual or firm whose name appears in the lists of "Accounts receivable" and "Accounts payable." When these accounts have been opened the inventory amounts under each head are carried to their respective accounts. All "asset" items are entered on the left-hand page of the accounts under "Charges" and the "liability" items as credits on the right-hand page. When all the entries as shown by the inventory have been made, the books are said to have been "opened." Each year, after the books have been finally closed and the results drawn off, the foregoing process is repeated for the accounts of the new year. Other accounts are afterwards opened throughout the year as items occur to be charged or credited to them.

CLOSING THE ACCOUNTS AT THE END OF THE YEAR

Although considerable time may be required to close a set of accounts, this part of the work usually comes at a time of the year when other work is not pressing and when weather conditions are more favorable to working indoors than out. A definite order of procedure should be adhered to in closing the accounts. The following order has proved satisfactory.

1. The first step is to take a final inventory in the same manner as at the beginning of the year.

2. Itemized statements should be requested from all dealers from whom goods are regularly bought on credit. These should all be inspected and any items thereon which have not yet been entered on the books should be entered at once. Memoranda should be made of amounts due the hired men or any other persons. For instance, if a month's wages, $45, is due the hired man, labor account should be charged and a personal account with the hired man credited with this amount. After the first of the new year, when this amount is paid to the hired man, the labor account of the new year should not be charged with it, but the personal account of the hired man should receive this charge and the account be closed. All accrued income and expense of every nature that pertains to the old year and is not yet entered on the books should be handled in this manner.

3. Accounts receivable should be inspected and handled in the same manner described in step No. 2. For instance, if last month's milk check has not yet been received, the amount thereof should be secured by telephone or otherwise and the proper entries made on the books as aforesaid.

4. The "Feed" records are next figured up to date and the corresponding entries made charging the animal accounts and crediting the crop accounts, or "Feed and supplies," as the case may be.

5. The various live-stock accounts should be credited with the value of any feeds charged to them at harvest, or time of purchase and not yet consumed, as they may appear in the final inventory. After the books are closed. the animal accounts for the new year should be charged in like amounts in opening the books, the values of these being thus deducted from the expenses of the year in which purchased and being charged against the year in which they were consumed. This is sound accounting practice, and is known as "reversing the entries."

6. The value of pasture utilized by the animals during the year should be charged to their respective accounts and "Pasture" account credited in like amount. The rate charged for pasture should be as near as possible the price for which pasture rents in the region. Pasture account should, of course, be charged with all the expenses of pasture maintenance, as well as for the use of land in pasture as hereafter described.

7. The value of farm produce used in the home, if not entered before, should be attended to next. Included in this would be estimates of the quantities of milk, butter, eggs, potatoes, apples, etc., used by the farmer and his household. Personal account should be charged with these values and the proper animal or crop accounts credited.

8. The value of the board, produce, or other allowances furnished the farm laborers should be estimated and the amount charged against "Labor" account, crediting "Personal" account with the value of the board and the crop or other accounts for the value of the produce or other allowances.

9. The value of the unpaid farm labor done by the farmer and members of his family who are not being paid regular wages should next be estimated and entered. "Labor" account should be charged and "Personal" account credited.

10. The animals should be credited with the value of the manure produced by them during the year and the total value of manure charged against the "Manure" account. These data can be secured from the "Manure" account in the Work Record if the latter has been properly kept.

11. Estimates of proper amounts for the use of the farm buildings for the year should be made. Each crop or class of animals, the "Personal" account, and the accounts with machinery and man labor should receive a charge

proportionate to its use of the buildings and the total amount so charged should be credited to the "Real estate" account. For example, charges for the use of barns on one farm were made as follows:

Distribution of annual charge for use of buildings

(Barns: Value $2,000; use for year at 10 per cent, $200)

Account to be charged.	Per cent of total charge.	Amount.
Cows	30	$60
Horses	20	40
Hogs	5	10
Machinery	10	20
Corn	5	10
Oats	10	20
Hay	20	40
Total	100	200

The use of other kinds of buildings is estimated in the same way, and when all have been so handled the total "Use of buildings" cost is found and charged to each account. As a general rule it is safe to charge 8 to 10 per cent of the current value of ordinary frame farm buildings as annual use cost or rent. Brick, stone, tile, and concrete buildings should take a somewhat lower rate.

12. The Work Record should next be reviewed and the hours and minutes of man labor charged to each account should be added up. The various totals should then be added together and the total hours of man labor found for the year.

13. The total net cost of the "Man-labor" account in the Financial Record should then be found by subtracting from the total of the charges the total of any credits. This net cost should then be divided by the total hours of man labor for the year. This gives the man-hour rate. It should be worked out in terms of cents and mills per man-hour.

14. The total hours of man labor, including chores, found against each account in the Work Record should be carried over to the charge page of the same accounts in the Financial Record. The hours should then be multiplied in each case by the man-hour rate (see step 13) and the cost in dollars and cents carried to the money columns, crediting "Man labor" account, item by item, with the same. When this has been completed the "Man labor" account will balance within a small amount. Any difference will be caused by the fact that the man-hour rate was not worked out to sufficient decimal places, as a difference in a tenth of a mill per hour where 6,000 hours are involved would make the account out of balance 60 cents. The difference, if any, may be carried to the "Loss and gain" account and entered on the charge side thereof, if the charge side of the "Man labor" account is greater, and on the credit side if the reverse be true.

15. The total hours and minutes of horse labor are next found in exactly the same manner as the man labor (step 12). Before the net cost of horse labor can be found, interest (at current rates for secured loans) must be charged (see step 20), and the final inventory value of the horses must be credited to their account. After this has been done the net cost of horse labor and the horse-hour rate are determined exactly as for man labor (step 13).

16. The total hours of horse labor against each account in the Work Record are next charged against the same accounts in the Financial Record, the values found by multiplying by the horse-hour rate and extended to the

money columns of the various accounts, and the sum total credited to the "Horse account" exactly similarly to the method of handling the man labor (step 14). If the "Horse account" does not finally balance, it is handled in the same way.

17. The distribution of the annual cost of using machinery is the next step, and it is handled just as were the man and horse labor costs, with a few important exceptions. The inventory value of machinery and any machinery parts on hand at the end of the year is first credited to the "Machinery" account in the Financial Record, interest charged (see step 20), and the net cost for the year ascertained. To distribute this cost is now the problem. There is no record of machinery hours, but such a record can be dug out of the various accounts in the Work Record if desired and an hour rate worked out for each important machine and group of minor tools. This is the most accurate manner in which this cost can be distributed, but while valuable results to the student and investigator would be obtained, it is doubtful whether the practical farmer would find them useful enough to pay for the long process of figuring involved. A shorter method will now be described. It will be assumed that for every hour a horse is worked machinery is also used, and therefore each account should have charged against it the same number of machinery hours as horse hours. Machinery cost may then be distributed on the basis of horse hours. There is only one hitch here. Horse hours have been charged to "Machinery" account, and therefore if this basis is used machinery will have recharged against it a certain proportion of its own cost. This can be obviated by first deducting from the total horse hours the number of horse hours charged to "Machinery" account and using the remainder as the basis for distributing the entire machinery cost. This should now be done, proceeding with the distribution exactly as explained for the man-labor cost (step 14).

18. Any other accounts of convenience, as "Manure," "Feed and supplies," "General expense," etc., should now be distributed and these accounts closed.

19. All other values in the final inventory, not already credited, should be carried to their respective accounts and credited on the right-hand pages thereof.

20. Interest, based on the average inventories of each account (except "Horses" and "Machinery," which have already been charged), should be charged thereto and "Interest" account credited with the total. The rate should be the same as that already used in the two accounts specified.

21. A proper charge to crops and pasture should now be made for the use of the land and the total credited to "Real estate" account. The rate per acre should be high enough to cover interest and taxes but not so high as to make "Real estate" account show any great profit. In fact the "Real estate" account should be, if possible, made to balance by the credit for use of land. This can be done by finding the net balance of the "Real estate" account and dividing by the number of acres to be charged with rent. This will give a rate per acre which can then be handled exactly like that of "Man labor," "Horse," and "Machinery" accounts, and any small balance remaining can be handled in the same way. A point to remember is that if the final inventory value of the real estate has been increased over that at the beginning of the year to keep pace with actual advances in real estate values in the locality, such advanced values should not be used in making the above distribution, but the amount of such advance should be first taken out of the account and carried to "Loss and gain" account as a separate, distinct gain.

22. Both sides of the crop, live stock, pasture, and any other enterprise accounts should now be footed up and the lesser total subtracted from the greater

to obtain the balance as shown by each account. These balances are now to be closed to " Loss and gain " account. If the charge side is greater in an account the excess represents a loss and should be carried to the "Loss and gain" account as such by entering it on the left-hand page under charges. If the credit side of an account be greater a profit has been made and should be carried accordingly to the credit side of the " Loss and gain " account. Table II illustrates a crop account on which a gain of $536.81 has been closed to " Loss and gain " account.

23. Both sides of the "Loss and gain" account should now be footed up, the lesser subtracted from the greater, and thus the net gain or loss for the year determined.

When all these steps have been completed the books are said to be finally "closed." It is a good plan to make up a Profit and Loss Statement for the year for convenience in further study of the year's business and to preserve, for comparison with similar statements for future years. Such a statement may be prepared in the following manner:

Statement of losses and gains, 1918

Account.	Number of acres or animals.	Losses.	Gains.	Per acre or animal.	
				Loss.	Gain.
Cows	19		$359.11		$18.90
Hogs	3		14.82		4.94
Poultry	82		19.65		.24
Corn	10.5		26.60		2.53
Potatoes	14		536.81		38.34
Wheat	4.5		35.17		7.80
Rye	3	$19.91		$6.64	
Oats	15	3.84		.26	
Buckwheat	5	13.63		2.73	
Peas	6		35.39		5.90
Hay	40		195.65		4.89
Orchard	3		148.52		49.51
General expense		151.45			
Totals		188.83	1,371.72		
Subtracting the lesser			188.83		
Net gain on farm enterprises			1,182.89		
Personal accounts:					
Interest			388.00		
Personal			373.85		
			1,944.74		

STUDY AND INTERPRETATION OF RESULTS

Unless studied, farm accounts are of little use to help make business more profitable in the future. It is just as important to study the different items of cost and returns in an account as to know whether or not it pays. Weather conditions, crop conditions, and market conditions for the year, as compared with an average year, must be considered. For instance, potatoes in some year may show heavy losses on many farms because of low prices or losses by rot. By studing the potato account to find the factors of production, and considering a normal yield and price for the locality, conclusions could be reached as to whether ordinarily it would or would not be profitable to raise potatoes.

The potato account in Table II when studied, yields the following figures:

Total acreage	14
Total yield (bushels)	1,128
Total cost	$735.24
Total value	$1,272.05
Total profit	$536.81
Yield per acre (bushels)	80.6
Cost per acre	$52.52
Value per acre	$90.86
Profit per acre	$38.34
Man hours per acre	57
Horse hours per acre	60
Labor cost per acre	$27.10
Cost per bushel	$0.652
Value per bushel	$1.128
Profit per bushel	$0.476
Net return per hour of man labor	$0.672

Besides the satisfaction of knowing which crops or enterprises paid and how much, there are many other ways in which the accounts may be useful. They may be used to study the seasonal distribution of the labor on the farm as a whole and on certain enterprises, disclosing just where the rush seasons occur and what causes them. They may be used to compare results with neighbors, or with published cost records in newspapers and bulletins. The results of such comparisons should be to teach methods by which labor can be saved, thus cheapening production and correspondingly increasing the chances of a good profit.

By keeping cost accounts an idea of the value of labor will be gained, it is soon discovered that time represents money, and that it is as important to save one as the other. The results set forth by the accounts will often give a farmer many surprises. Sometimes it is found that the enterprises which he thinks are the best and to which he devotes most of his time do not show up so well financially as the enterprises that get little attention.

Cost accounts, carefully and consistently kept, year after year, are certain to develop both the business of farming and the farmer's power of analyzing the causes and effects involved in his operations.

PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE AND STATE INSTITUTIONS RELATING TO FARM COST ACCOUNTING

[Many of the bulletins in this list may be obtained free upon application to the United States Department of Agriculture, or to the agricultural experiment station of the proper State; the others may be consulted in agricultural college libraries.]

METHODS OF FARM ACCOUNTING

A Method of Analyzing the Farm Business. (U. S. Dept. Agr. Farmers' Bulletin 661.)
Farm Bookkeeping. (U. S. Dept. Agr. Farmers' Bulletin 511.)
The Use of a Diary for Farm Accounts. (U. S. Dept. Agr. Farmers' Bulletin 782.)
Value of Records to the Farmer. (U. S. Dept. Agr. Yearbook Separate 735.)
Farm Records and Accounts. (Montana Agr. Exp. Sta. Circular 43.)
Real Profits from the Dairy Business as Measured by Cost Accounting. (New York Dept. Agr. Bulletin 86.)

COST OF PRODUCTION

An Economic Study of Farming in Sumter County, Georgia. (U. S. Dept. Agr. Bul. 492.)
A Farm-Management Survey in Brooks County, Georgia. (U. S. Dept. Agr. Bul. 648.)
A Farm-Management Study in Anderson County, South Carolina. U. S. Dept. Agr. Bul. 651.)
A Farm-Management Study of Cotton Farms of Ellis County, Tex. (U. S. Dept. Agr. Bul. 659.)
Cost of Market Milk. (U. S. Dept. Agr. Farmers' Bul. 469.)
The Cost of Milk Production Computed on the Year Basis. (Illinois Agr. Exp. Sta. Bul. 216.)
Dairy Production in Ohio. (Ohio Agr. Exp. Sta. Bul. 334.)
The Cost of Producing Farm Products; Methods of Investigation; Cost of Growing Minnesota Field Crops, 1902, 1903, 1904. (U. S. Dept. Agr., Bur. Statis. Bul. 48; Minnesota Agr. Exp. Sta. Bul. 97.)
The Cost of Production of Corn and Oats in Illinois in 1896. (Illinois Agr. Exp. Sta. Bul. 50.)
The Cost of Production on Missouri Farms. (Missouri Agr. Exp. Sta. Bul. 125.)
Labor Requirements of Crop Production. (Minnesota Agr. Exp. Sta. Bul. 157.)
The Cost of Crop Production. (New York Dept. of Agr. Bul. 86, p. 2251–2257.)
Amount and Cost of Labor Required for Growing Crops in West Virginia. (West Virginia Agr. Exp. Sta. Bul. 163.)
Cost Accounts on Some New York Farms. (New York Cornell Agr. Exp. Sta. Bul. 377.)
Cost of Farm Crops. (Nebraska Agr. Exp. Sta. Bul. 29. 1893.)
Results of Three Years' Experiments in Cost and Profit of Growing Wheat. (Wyoming Agr. Exp. Sta. Bul. 25.)

Farm Cost on the Colorado Agricultural College Farm. (Colorado Agr. Exp. Sta. Bul. 203.)

Cost of Producing Field Crops, 1908–1912. (Minnesota Farmers' Library Agr. Ext. Bul. 59.)

The Cost of Minnesota Dairy Products, 1904–1909. (Minnesota Agr. Exp. Sta. Bul. 124; U. S. Dept. Agr., Bur. Statis. Bul. 88.)

The Cost of Growing Wheat on Typical Nonirrigated Areas in Montana. (Montana Agr. Exp. Sta. Bul. 122.)

Cost of Milk Production. (New York State Dept. Agr. Bul. 35.)

Records of a Dairy Herd for Five Years. (Connecticut Storrs Agr. Exp. Sta. Bul. 7.)

Cost of Milk Production. (New Hampshire Col. and Exp. Sta. Ext. Bul. 2.)

The Cost of Milk Production. (New York Cornell Agr. Exp. Sta. Bul. 357.)

Cost of Producing Milk on 174 Farms in Delaware County, New York. (New York Cornell Agr. Exp. Sta. Bul. 364.)

Studies in the Cost of Market Milk Production. (Michigan Agr. Exp. Sta. Bul. 277.)

The Cost of Milk Production. (Massachusetts Agr. Col. Ext. Bul. 11.)

Cost of Producing Milk on Four Dairy Farms Located in Wisconsin, Michigan, Pennsylvania, and North Carolina. (U. S. Dept. Agr. Bul. 501.)

The Cost of Milk and Fat Production in Vermont in 1911 and 1912. (Vermont Agr. Exp. Sta. Bul. 202.)

The Cost of Producing Market Milk in 1916–17 on 212 Vermont Farms. (Vermont Agr. Exp. Sta. Bul. 209; Vermont Col. Agr. Ext. Circ. 7.)

The Cost of Milk Production in Massachusetts. (Massachusetts Agr. Col. Ext. Bul. 19.)

Milk Production Costs and Milk Prices. (Missouri Agr. Exp. Sta. Bul. 156.)

Profits from Milk Cows on General Cornbelt Farms. (Missouri Agr. Exp. Sta. Bul. 159.)

The Cost of Milk Production. (Minnesota Agr. Exp. Sta. Bul. 173.)

The Cost of Producing Minnesota Field Crops, 1913–1917. (Minnesota Agr. Exp. Sta. Bul. 179.)

Cost of Growing Crops in Nebraska. (Nebraska Agr. Exp. Sta. Bul. 122.)

Investigation of the Cost of Milk Production in Western Washington. (Western Washington Agr. Exp. Sta., Mp. Bul. v. 6, No. 5, p. 63–69.)

The Cost of Producing Minnesota Farm Products, 1902–1907. U. S. Dept. Agr., Bur. Statis. Bul. 73; Minnesota Agr. Exp. Sta. Bul. 117.)

Cost of Producting Farm Crops. (North Dakota Agr. Exp. Sta. Bul. 104.)

The Cost of Producing Minnesota Farm Products, 1908–1912. (Minnesota Agr. Exp. Sta. Bul. 145.)

The Cost and Feeding Value of the Dry Matter of Dried Corn Fodder and of Silage. New Jersey Agr. Exp. Sta. Bul. 122.)

Further Experiments on the Economic Value of Root Crops for New York. (New York Cornell Agr. Exp. Sta. Bul. 317.)

Labor Cost of Producing Corn in Ohio. (Ohio Agr. Exp. Sta. Bul. 266.)

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U.S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN
573

Contribution from the Bureau of Animal Industry, A. D. Melvin, Chief.
April 27, 1914.

THE ANGORA GOAT.

By L. L. **Heller**, *Animal Husbandry Division.*

INTRODUCTION.

UNIVERSI GENERAL LIBRARY 1819

The value of the 1909 clip of mohair in the United States was $901,597, nearly four times that of the clip of 1899. The number of fleeces of mohair reported in the census as shorn in 1899 was 454,932 against 1,682,912 for 1909. Of this latter number 1,077,463 were reported from Texas, 155,980 from New Mexico, and 141,588 from Oregon. Arizona and California each reported over 100,000 and Missouri was the only other State with over 20,000 fleeces of mohair

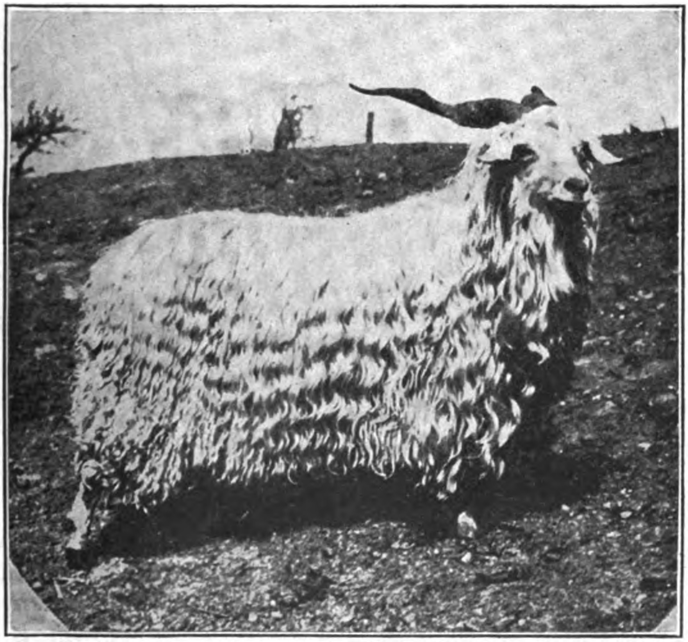

Fig. 1.—Angora buck.

Note.—This is a popular paper suitable for present and prospective Angora goat raisers; it is especially adapted to the Southwest and the recently cleared portions of the North and Northwest.

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in 1909. The average weight of the Oregon fleeces was 3.7 pounds and of the Texas fleeces 1.85 pounds. Many of the Texas Angoras are shorn twice a year, however, and the yield per goat is therefore undoubtedly much above the census figure for the average weight per fleece in that State. Estimating that one-third of the Texas goats are double shorn, it appears that the total number of goats of shearing age in the United States in 1909 was about an even million. This number probably includes all goats of shearing age having enough Angora blood to make shearing profitable.

During this same time there has been a decided drop in the number of sheep and beef cattle in America. The records made by the Angora during the first decade of this century show up strongly in contrast with those of the other classes of live stock named. A few years ago the industry was largely localized in the Southwest, while now almost every State in America possesses its flocks. In the Northwest especially the Angora has found a veritable paradise in the large areas of logged-off lands with their humid climate, and this section is almost unrivaled for the production of high quality mohair. If these lands are allowed to grow up in brush they become a dangerous fire trap and are a menace to the surrounding country. The Angora eliminates this danger, helps to clear up the land, and returns a considerable income at the same time.

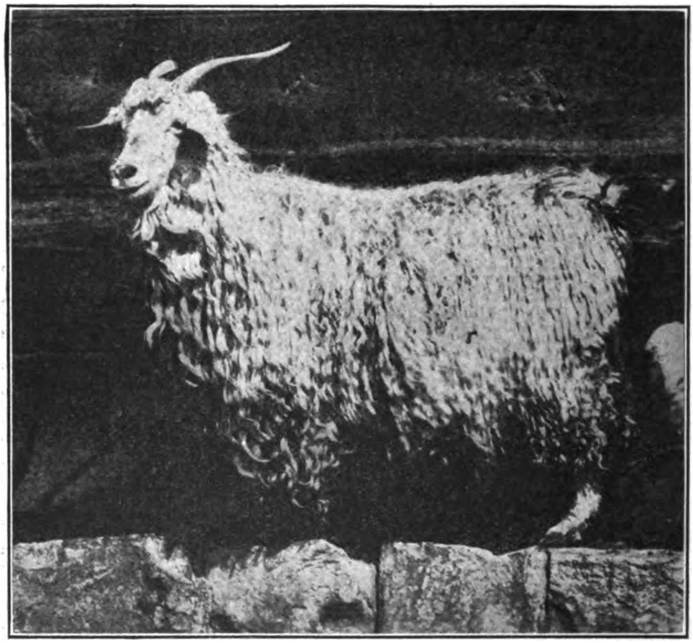

FIG. 2.—Angora doe.

Accompanying the increasing esteem in which the Angora has been held as a clearer of brush land, there has been a steady increase in the price of mohair received by the grower. In 1908 the price ranged between 22 and 25 cents, while in 1913 it averaged about 34 cents per pound.

ORIGIN AND DISTRIBUTION.

The Angora originated in the vilayet of Angora in Asia Minor. This location and South Africa are to-day the two large foreign centers of mohair production.

The Sultan of Turkey passed an edict in 1881 prohibiting the exportation of Angoras, expecting thereby to confine the industry to Asia Minor and have a monopoly upon the mohair trade.

In 1901 South Africa also passed a law for the same purpose, which is usually referred to as the Angora export-duty act. This act provided for an export duty of £100 ($486.65) on each Angora goat exported. Since that time importations have been entirely prohibited.

It was feared for a time that prohibiting the importation of breeding stock would have a bad effect upon the industry in America, but later evidence has indicated that some of the best blood had already been brought to the United States and that deterioration apparently does not take place here, as experts say that the best American product is equal to the best grown in Turkey or South Africa.

Faith in the excellence of American Angoras has been demonstrated by other nations, as quite a number of exportations have been made from the United States. In 1894 six Angoras were exported to South Africa from California and the next year 20 bucks followed for $1,000 cash. Canada, Alaska, and some of the Pacific Islands also have flocks that came originally from California. Recently exportations have been made to Brazil and Argentine Republic.

The Angora was evidently bred pure in Asia Minor for many years previous to the last half century. About 50 years ago they were largely crossed upon the common Kurd goats of the district. Some authorities give their opinion to the effect that not a flock escaped the influx of Kurd blood. This has generally been considered a very harmful proceeding, and many hold that kemp in the Angora's fleece is still an outward sign of the presence of this foreign blood.

The Angora, as brought from Turkey, was considered too small for American purposes and was largely crossed upon the common goat. One eminent Angora authority has said that he doubted whether there was a purebred Angora in America. This statement is probably a little overdrawn, as other well-known Angora breeders claim that some flocks have been kept entirely pure, but undoubtedly crossing was at one time a very common practice. The purposes were to obtain a larger, hardier animal, and to increase the breeding stock. This has largely been accomplished and it is the general opinion that the American Angora is better suited to local conditions and gives wider satisfaction than the original could ever have done.

DESCRIPTION OF THE AMERICAN ANGORA.

The Angora, as bred in the United States, is almost always pure white, but occasionally a black one appears. Some profess to see in this the cropping out of impure strains of blood. Both sexes are usually horned, but polled individuals occur. The ears are either partially erect or pendulous. The body should be built upon lines denoting a good constitution and should be symmetrical. The fleece should cover all parts of the body except the inside of the upper part of the legs; should be of fine quality, closely curled, of a high luster, and as nearly as possible free from kemp.

IMPORTANCE OF THE ANGORA.

New uses are constantly being found for the Angora. Their value in clearing up brush lands has been mentioned in the introduction, but it is worthy of more extended discussion. It is estimated that there are 3,000,000 acres of logged-off lands in the Northwest that could be profitably converted into homesteads. Already many fields in this section have been enabled to smile under bountiful harvests made possible by the repeated browsing off of the brush by the Angora. Many settlers who have developed farms in this section are loud in their praises of the Angoras and attribute their rapid progress to the use of this animal.

The following indicates a new use to which the Angora has been placed in the West.

> *Angora goats to prevent forest fires.*—In order to keep the fire breaks on the southern California forest reserves clear of weeds, an ingenious plan has been put into operation which will save the Government thousands of dollars and incidentally provide forage for large herds of Angora goats. The plan was originated by Forest Supervisor R. H. Charlton, of Los Angeles, and provides for free grazing for a herd of 600 goats on the reserve. They were shipped into the State from Arizona and allowed to roam at will over the parts of the range where their services are required. Their help to the forest rangers is in keeping down the growth of weeds, grass and small shrubs on the strips of cleared land, known as fire breaks, which follow the ridges through the forest and serve to check the spreading of forest fires. These fire breaks are of little value unless all such growth is kept down, as the weeds and grass dry up in California summers and would carry the flames across the clearings. The goats feed close, keeping the fire breaks bare of vegetation, and thus do the work of gangs of laborers. In this way the Government's pay roll is kept down, while the owners of the goats are provided with free grazing for their herds.

The Interurban Railway Company between Seattle and Tacoma recently purchased a band of Angoras to keep their right of way clean and attractive. The above two are simply examples of a general type that may suggest local uses to which the Angora might be suitable.

It should not be thought that the West is the only part of the country where the Angora will fit in. In the Central West, many pasture fields that have "grown up" while other stock was being pastured upon them could be reclaimed and made to carry more stock by their use. In the South there are also many abandoned fields that might profitably pasture a band of Angoras and gradually be made ready for cultivation.

While the Angora will get along upon grass and weeds it is more satisfactory to have browse in connection with these. Browsing is the natural way for them to feed and they do not generally give the best results unless they have access to a certain amount of brush, etc. However, it should be stated that rough brush land is not suitable for growing extra long mohair, especially after the fleece is about 6 inches long.

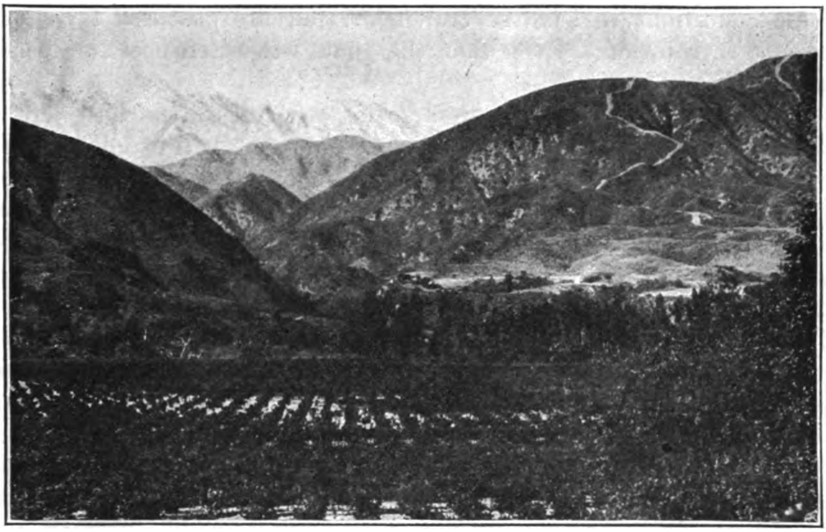

FIG. 3.—Fire breaks in a Western forest region kept clean by the use of Angoras. The breaks extend along the top of the ridges and are indicated by the light zigzag line at the right of the picture.

The question as to whether goats can be pastured with other live stock can be answered in the affirmative. Their presence is in no way objectionable to cattle and sheep. In the case of the latter a few goats are often allowed to run with the flock for the purpose of keeping the dogs away. It is doubtful whether this purpose is accomplished, as there are instances where the goats themselves have been killed, but it illustrates the point that the sheep and goats feed together satisfactorily.

Allowing goats to run with horses is not objectionable to the latter, but there is danger of the goats being kicked. Accordingly, this plan does not give very great satisfaction. This is even more true with jacks and young mules. Pasturing with hogs is generally impractical because of the danger of the hogs devouring the young kids.

Regarding the number of goats that can be pastured per acre, only general figures can be given. The soil, length of pasture season, the climate and whether the pasture is to be permanent or the goats turned in merely to clean up the brush are some of the factors deciding this. There are sections unsuitable for cultivating purposes where it might be desirable to pasture the goats year after year. Eating off the browse too closely would kill it, hence it is desirable under these conditions to have several fields that are pastured for short periods in rotation. Even then the goats will often peel the brush and gradually destroy it.

For cleaning up brush land for other agricultural purposes from two to five goats per acre from two to four years will usually do the work. It has been asserted that the Angora can eat all kinds of poisonous plants without ill effects. They naturally feed upon a wide variety of vegetation, browsing a leaf here and another there and the amount of the poisonous plants consumed at any one time is usually small. No bad results would be likely under these conditions. There are other records of where hungry goats have been turned in upon fields containing little else than poisonous plants and of large numbers dying because of having eaten heavily of them. This has been found true of the laurel plant especially. Green brier has also been found objectionable but from another standpoint. This applies especially to goats with considerable length of fleece. They become entangled among the vines and frequently die, being unable to free themselves.

VALUE AND USE OF MOHAIR.

It has often been said that the Angora works and pays for its board at the same time. The value of the fleece or mohair is considerable and is increasing. The ideal fleece should possess length, quality or fineness, luster, strength of fiber, freedom from kemp, and it should be closely curled but not kinky. Mohair is made into plush for railroad cars and upholstering furniture. It is also used for automobile tops, coat linings, dress goods, men's summer suits, braids, rugs, carriage robes, imitation furs, couch and table covers, sofa pillows, portieres, and curled false human hair. For a number of years the price of mohair varied between wide limitations, depending upon the decree of fashion, but during the past few years there has been a steady increase in price, undoubtedly caused by the more extended use of the article, and fashion no longer plays an important rôle in determining its value.

The weight of fleece for American Angoras ranges from 2 to 12 pounds. The average weight of fleece has been placed at 2½ pounds for one year's growth. Shearing once a year is practiced, except in the Southwest. Here climatic conditions are such that the Angoras often shed their fleeces if not clipped twice, hence they are usually sheared both in the spring and fall. Where the fleece is allowed to grow for 12 months the average length is about 10 inches. The total production of mohair in the United States for 1913 will probably approach 5,000,000 pounds. The best of it comes from the Northwest. In Oregon, Polk County leads and the product of this county has sold for from 42 to 55 cents per pound for the past few years. The Northwest Angora Goat Association reports an average cash production of about $1.75 per head, with many flocks averaging as much as $2.25. From superior flocks of California and Oregon it is not unusual to get 15 to 20 inch staple in one year's growth. In Texas and New Mexico much mohair falls under the 6-inch standard (because of shearing twice a year), which is the shortest length generally desired. The short product is largely responsible for the lower average quality of American mohair. The Southwestern product shrinks heavier than that from other sections. This is especially true of the Arizona and New Mexico product, but some Texas hair shrinks as light as 5 per cent. California mohair often has a characteristic reddish cast.

Notwithstanding the large domestic production about 2,000,000 pounds of mohair are annually imported into the United States. The imported mohair is of better quality than the average American product. If the practice of clipping twice a year could be abolished, the difference in quality would probably largely disappear, as these short fleeces reduce the average quality to a considerable extent. The shrinkage of American hair is said to average more than that imported, but some American authorities dispute this statement. The shrinkage is estimated at from 12 to 15 per cent. The shrinkage of Arizona and New Mexico mohair is largely due to dirt, etc., while that of the Oregon hair is caused by natural grease. In most cases the foreign mohair is blended with the American product and spun in this manner. The aim for future advancements in this industry should be toward increasing the average quality rather than the quantity of mohair produced. There need be no discouragement in this, as it has already been said that the best mohair of this country is equal to any produced. Another word of encouragement spoken by competent authorities praises the marked improvement that has already taken place in American mohair, both in the matter of quality and freedom from kemp.

The best mohair comes from the kids, the young wethers, and does. As the goats grow older the hair becomes coarser and gradually loses its luster and curling qualities. The production of extra long mohair, from 12 to 24 inches, has been the subject for considerable discussion of late. This quality of goods is used for making false hair, etc., and sells for a much higher price than the ordinary grades. A notable instance is the one of the fleece of Romeo, sweepstakes buck at the El Paso show in 1910. It weighed 18 pounds, measured 20¾ inches in length, and sold for $115. This quality of hair could not be grown, however, under average conditions. It could not be produced upon rough brush land nor under any conditions where feed and care were not the best. In the Southwest it would be difficult to produce it, on account of climatic conditions, yet some breeders have succeeded in producing an excellent quality of fiber in this section.

As a rule, the extra long fleeces must be allowed to grow for a longer time than 12 months. Some authorities claim that certain non-shedding goats are essential for the production of the extra long fleeces; others dispute this, maintaining that care, food, and climatic conditions are the deciding factors.

CARE OF FLEECE.

Mohair fleeces should not be tied, but should be rolled up, cut side in, and packed in suitable bags. Bags that have previously been used for wool should never be used, as the wool fiber that adheres to the sides becomes mixed with the mohair. It will not take the dye used for mohair, and is the source of considerable trouble in the manufactured goods.

A great deal of American mohair is sold direct to the mills by the producer. Quite often it is pooled, and the growers of the Northwest have realized considerably better prices by this method of sale. Commission men also handle this product. Some of the principal mills in this country are the Sanford Mills, Sanford, Me.; the Massachusetts Mohair Plush Co., Lowell, Mass.; the Queensbury Mills, Worcester, Mass.; and the Multnomah Mills, Portland, Oreg.

The skins of Angoras with the hair attached are sometimes tanned for rugs and carriage robes. This material is also used for making muffs, trimming coats, etc. It makes a very attractive "fur." With the hair removed, the skins are also tanned and made into leather. This is not suitable for the production of kid gloves or shoes, but is sometimes made into morocco and similar grades, the poorer product being used for the manufacture of workmen's gloves.

ANGORA MUTTON.

The flesh of the young Angora is delicious, although there has been a prejudice against its use. Kansas City is the leading goat market in America. Two classes of goats are offered for sale, designated as "fat" and "brushers." The fat class are those in condition for slaughtering and the "brushers," as their name would indicate, are stockers of the caprine family. The average weight of goats at Kansas City is 68 pounds.

Because of the prejudice against Angora mutton it has been almost invariably passed over the counter as lamb. In Oregon a law has been passed making it necessary to properly label the carcass. That the Angora will not suffer from this is evinced by the fact that the carcasses have previously sold as lamb and that the consumer has been unable to detect any difference. As soon as the excellence of Angora mutton is more commonly appreciated it will undoubtedly be in greater demand and its value will be enhanced accordingly.

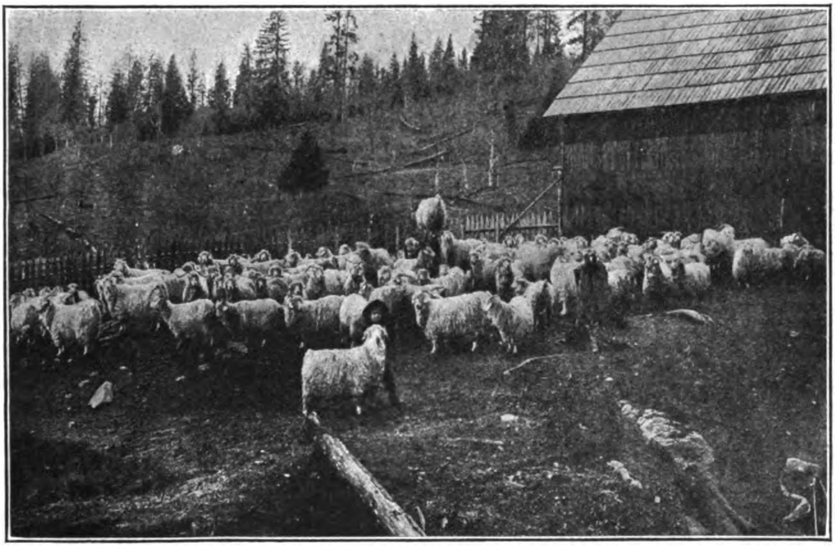

FIG. 4.—An Angora flock in the Northwest.

ADAPTABILITY OF ANGORAS.

So far as temperatures are concerned the Angora should flourish in any part of the United States. In Turkey and South Africa the ranges in temperature are almost if not quite as great as those of the United States. It is claimed that the coldest weather will not affect them, provided it is dry. In Montana the goats are undaunted by the heavy snowfalls so long as they have a dry place for the night.

In Texas, New Mexico, and Arizona the high temperatures make it necessary to shear the goats twice a year but the heat has apparently no ill effects upon the health of the flocks.

Wet and swampy land, wherever it may be, is unsuitable for Angoras. The native home of all goats is upon the high hills and mountains and their preference for altitudes is still manifested by their ascending to the highest available point, if it is only the feed trough. (Fig. 4.)

Well-drained land and pure water are very essential for the health of the flock. The fact that these conditions are common to considerable portions of this country, and that flocks of Angoras are to be found in almost every State, would indicate that the country as a whole is fairly well adapted to the Angora industry. However, a closer scrutiny of the conditions will show that some sections are especially favored and that the industry will probably always be largely confined to these. The large areas of new lands, the comparative low values of these, and the almost ideal climate have combined to create and maintain the industry in the Willamette Valley and the surrounding country, and the great amount of cheap range lands in Texas, Arizona, and New Mexico has fostered it in the Southwest.

BUILDING UP A FLOCK.

As mentioned before in this bulletin, when Angoras were first brought to America, considerable crossing was practiced with the common goat. At that time breeding stock was scarce and it was necessary to increase the supply by any practical means. It was found that the first and second crosses upon the common goat produced little mohair and a large amount of kemp and that it was necessary to cross with a pure Angora five or six times before a really superior animal could be produced. In the past the fifth cross has been considered to produce a purebred. Beginning with common does and crossing with Angora bucks was necessary at the beginning of the industry, but it would no longer be profitable to start a flock in this way. It would be far better to buy a few purebred Angoras outright and develop a flock from these by the natural increase.

MANAGEMENT OF THE FLOCK.

Contrary to a formerly common opinion Angoras need considerable care and personal attention. The kids are especially in need of this and if it is denied them a large mortality among them often results. For this reason it has been found inadvisable to turn them out with the does before they are 6 weeks or 2 months old.

Sheds or other shelter must be furnished both the adults and the young and if the country is infested with dogs or wild animals a dog and wolf proof fence should be built about the pasture. The expense of this will be repaid in a few years.

The management of a flock of Angoras does not differ radically from that of a flock of sheep. It is not considered necessary to have a herder constantly present with the flock. A dog is often sent out to herd and guard them, the herder riding out two or three times during the day to note the direction of the flock and to see that they do not roam too widely.

BREEDING.

The age at which the does should be bred has an important bearing on the welfare of the flock. The general opinion prevails that if they are forced to bear the burden of reproduction before they are 18 months old their growth will be stunted. Neither is it regarded advisable to use the bucks for breeding purposes before they attain this age.

The goats are supposed to be in their prime when from 2 to 6 years of age, but they have been known to reproduce regularly up to the age of 15 years. It does not generally pay to keep them too long, as the mohair becomes continually coarser with advancing age.

The does come in heat during August and September. The bucks also have a period of heat, but it usually starts sooner and lasts longer than that of the does. The time the does should be bred depends upon the climate. The kids are not so hearty or able to take care of themselves as lambs. If they come early and have not proper shelter and care a great many of them will die if the weather is cold and wet. A single bad night has caused the loss of 50 per cent of the kid crop in flocks of the Southwest where the shelter was insufficient.

The number of does a buck will cover satisfactorily depends upon the vigor and fertility of the individual and the care and food received. From 40 to 50 is a common average. The gestation period is from 147 to 155 days, or 5 months, as it is more commonly expressed.

NUMBER OF KIDS.

The does usually drop single kids, twins being rather uncommon. The Tariff Board found that the kid crop in the flocks investigated was about 65 per cent. Some authorities hold this figure too low. It is certain that in some well-managed flocks the average is from 100 to 120 per cent. A record of extraordinary fecundity is the one of a doe that produced twins, quadruplets, and triplets in three successive seasons.

FEEDING.

It is a good plan to feed a little heavier previous to kidding to start the milk flow. A small amount of grain is often desirable. It is not meant by this that the goats should be underfed at other seasons of the the year. Some people have been of the opinion that all that is necessary for the Angora is to turn them out in the winter, regardless of the depth of snow. They can not be expected to browse under these conditions if they can not reach the twigs. Some breeders cut down the high trees and this makes very satisfactory browsing, but other feed, both hay and grain, is necessary, especially in northern climates, if good results are to be expected. Flocks have been wintered out, however, without artificial feeding as far north as Nevada.

Angoras are very particular about the cleanliness of their feed and if it be pulled out of the manger and trampled under foot they refuse to touch it. For this reason it is considered the better plan to have an opening in the manger large enough to permit the entrance of the goat's head rather than to make it small, thus necessitating the pulling out of the hay in bunches with a large part of it falling upon the ground.

SHEARING.

In the Southwest shearing is done during February and March in the spring and the fall clip is removed in September or October. In other sections shearing usually takes place during March and April. It should be done before shedding begins, but it should not take place too early or the goats may suffer severely from the cold. Both hand shears and machines are used, but shearing by the latter means has increased rapidly during the last few years.

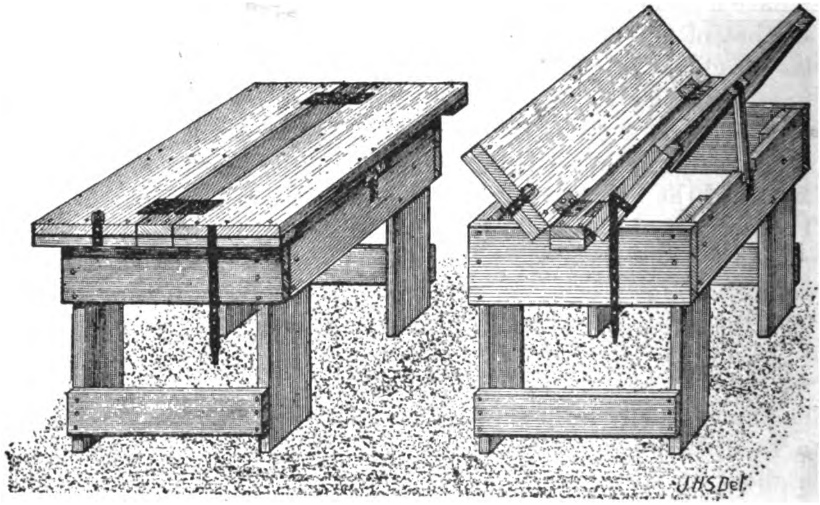

FIG. 5.—Conbination shearing trough and table.

Goats are not so gentle in the hands of the shearer as sheep, and many men, especially beginners in the industry, are anxious to know how best to handle them during the operation of shearing.

The late F. W. Ludlow, of Lake Valley, N. Mex., devised a shearing table which has proved to be of great service. It is a collapsible trough, or combination table and trough.

Mr. Ludlow's description of this table is given herewith:

> The table is simple in construction. It is about 22 inches high, 2 feet 10 inches long, and 21 inches wide. The top is composed of two 9-inch sides, which are hinged to the 3-inch centerpiece. On the lower side of these movable flaps is a narrow piece 8 inches long, which catches on the framework of the table when the sides are lifted and holds them stationary. When the sides are elevated the top of the table forms a

trough 3 inches wide at the bottom and possibly a foot wide at the top. Into this trough the goat to be shorn is thrown, feet up. A small strap, which hangs from the end of one of the sides, is run over the goat's neck and fastened to the other side. The goat's head is hanging over the end of the table and the strap prevents it getting free. The belly and legs are then shorn. The legs of the goat are then tied together, the strap removed from the neck, and the sides of the table dropped, so that one has a plane surface on which to shear the rest of the animal. An untrained man can shear 100 goats a day with a shearing machine and such a table.

THE KIDDING SEASON.

The kidding season is an important one upon the Angora farm, and problems are presented that are often puzzling, especially to the beginner. The following two methods of handling the flock as desrribed by a western breeder have given quite general satisfaction.

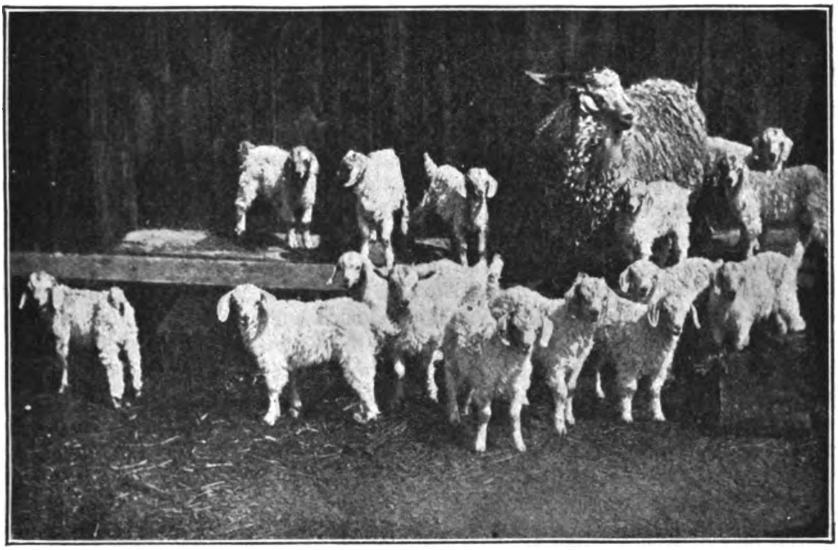

FIG. 6.—Group of Angora kids.

The corral method.—This method may be used with any number of goats. With various modifications and adaptations which best suit the size of the flock, the climatic conditions, the facilities for feeding, etc., it may be used by the beginner with success. We have practiced this method in Nevada for more than 25 years. If the herd is a large one, say 1,000 head, three men are required to handle the goats at kidding time. The service of the bucks is so managed that the kids will be dropped gradually through several weeks. At the height of the season we expect from 75 to 100 kids a day. The season lasts about 30 or 40 days. Fortunately, most of the kids are dropped in the daytime.

We have four or five small corrals fenced with 36-inch woven wire and large enough to hold 50 does and their kids. The doe should be allowed plenty of room, because if too close to her neighbor she may adopt the other doe's kid. Besides these small corrals, two large ones are needed, each large enough to hold 1,000 does. Along the fence of one of these corrals are a dozen small pens just large enough to hold a doe and kid. At the gate of this large corral a jump board is placed. This jump board is intended to keep back those kids which are not large and strong enough to jump over it. A 2-inch board about 18 inches high will answer the purpose. Another device sometimes used is a platform open at the end, so that the kids may run under it, and thus avoid being trampled upon when the goats are going out over the platform.

The small corrals may be made of panel fence and located in a meadow where some feed is afforded. The does should always have some kind of feed at kidding time.

In the morning the flock is carefully examined, and all does which show signs of kidding during the day should be separated and placed in one of the small corrals. The large flock is now turned out, and one of the men is sent with them with instructions to take the herd at once as far as he intends to go for feed that day, and then to let them feed over a limited area and gradually work their way home. A few does will drop their kids on the range, and the herder should carefully note the number and their location. He should see that the herd does not feed around one of these does, as she is apt to leave her kid and join the band, thus necessitating much extra work in finding the kid and in giving it to its mother. Early in the afternoon the band is placed in one of the large corrals. Now, the herder and another man go out with a wagon or on foot and carry the kids home, gently driving the mothers. The kids should not be handled or rubbed against one another more than is necessary, as the doe knows her kid by the scent. These does and kids are placed in the small corral which contains the does held back in the morning with the expectation that they would kid during the day. We now have one day's kidding in one of the small corrals. The does and kids should be watched to see that they are properly arranged. Do not bother them more than is absolutely necessary. Do not be in a hurry to make a doe own a kid. Do not drive the goats around one of the small pens.

The does should remain with their kids in the corral for a day or two at least, or until the kids are properly mothered. Any does which have not kidded should be taken out. The next morning any kids which may have been born during the night are put in another small corral with their mothers, as well as the does which are expected to kid during the day. The procedure of the previous day is repeated. In about three days, if one has limited quarters, the first day's mothers and kids may be put in the second large corral—that is, the one with the jump board at the gate. Now this "wet" band is placed in charge of one of the men and sent out to feed. The gate is opened, the mothers passing out over the jump board, and the kids remain in the corral. The herder must not range his goats near the does that are kidding upon the range, and he should be cautioned to come in later than the "dry" band, so as to avoid any possibility of their mixing. When his band arrives at the corral, the gate is opened and each mother hunts for her kid. Some of the kids may not find their mothers, and if after a day or two there are a few unnourished kids and some does with overdistended udders they should be placed together in the small pens along the side of the corral. The doe will own the kid in a day or two whether she is its mother or not. The kids should not be allowed to become too weak before this is done. If one does not have enough small pens a doe may be held while two or three kids suckle her, and thus tide them over until some of the small pens are vacant.

The next day the second day's kidding is added to the wet band. The wet band thus gradually grows, while the dry band decreases. During the day two men will be employed at herding the dry and wet bands, respectively, and the third man will be kept busy inspecting the kids, feeding the does in confinement, etc. If the weather is stormy, some of the kids will have to be sheltered. The advisability of having kids dropped gradually through a period of 30 or 40 days will readily be seen. If help is inexperienced, thay may be gradually trained, or if the weather is stormy there will be time to get all things arranged properly.

The kids should not be allowed to go with their mothers until they are about 6 or 8 weeks old. If they go before this, they will probably become tired very soon and go to sleep. When they awake, the band will have gone and they are liable to be lost.

During the day, while the mothers are feeding, the kids would eat a little grass if they could be herded near the corral.

As stated before, there may be many modifications of this method which will suggest themselves, but the above is a general outline of a method commonly in use.

The staking method.—This method is largely employed, even with large flocks, in New Mexico, but is possibly best suited to small flocks. It is without doubt the best method for certain surroundings. About the same amount of help will be required as with the corral method. There should be a good supply of stakes similar to tent stakes. There should also be a supply of swivel blocks which are about 4 inches long and having a hole bored near each end. A piece of rope about 6 inches long is fastened to the stake and the other end is passed through one of the holes in the swivel block and a knot tied in the end. Another piece of rope of equal length is likewise knotted and passed through the other hole of the swivel block, the loose end being tied to the kid's leg. Any swivel will take the place of this primitive method. The herder or owner can busy himself during the winter months by making stakes and swivels and by cutting and attaching the ropes.

When a kid is born it is taken to a convenient place to stake, and the mother is gently coaxed to follow. The stake is securely driven into the ground, and the kid fastened to it by the hind leg. The mother is left with the kid in order that she may know where to find it upon return from feeding. The kid should be staked where he can get plenty of sunshine, shade, and shelter. A small bush, a post, or a box will answer the purpose admirably. If there are twins, they must be so staked that they can suckle at the same time. The rope should be changed from one hind leg to the other occasionally to prevent unequal development. Sometimes a vigorous kid gets thoroughly tangled and requires help.

The kid may thus be left staked until he is old enough to go with the flock, which is after six or eight weeks, or he may be put in a corral after a few days, as is done in the corral method.

There are many successful breeders who use this method entirely. One may expect to get good results if he follows either the corral or staking method carefully.

There is very small loss among kids cared for as set forth above. Many of the breeders on a large scale report the percentage of increase as 100. This does not mean that every kid lives, but that so few die that the loss is offset by the number of twins that are dropped.

The most practicable fencing to be used at kidding time is made of portable panels. By the use of these panels a pen may be made large or small, and be moved from one place to another without difficulty and with very little work.

Does will occasionally refuse to own their kids. In such cases they should be tied up and compelled to allow the kid to suck. Small claiming pens are handy for these unmotherlike creatures. Tying a dog near them has had the effect of inducing them to mother their offspring sooner than they would have otherwise done.

CASTRATION.

All buck kids not intended for breeding purposes should be castrated when from 2 to 4 weeks old. This is best accomplished by cutting off the lower third of the scrotum with a sharp knife, forcing down the testicles one at a time with the thumb and forefinger of one hand and pulling them out with the spermatic cord attached with the other hand. A good firm grip should be taken so that one's fingers do not slip off. A 3 to 5 per cent solution of creolin or carbolic acid will keep out infection and repel the flies.

WEANING.

Kids should be weaned when from 4 to 5 months of age. Buck kids older than 5 months should never be allowed to run with the does, as they will often breed, beside causing endless annoyance to the does.

ASSOCIATIONS.

The American Angora Goat Breeders' Association was organized in 1900. This association up to the present time has recorded about 50,000 animals. Mr. R. C. Johnston, Lawrence, Kans., is the present secretary. There can be no doubt but that the association has done the industry a great deal of good. There has been considerable agitation in favor of an advanced registry, based upon superiority of the animals entered, but it is not possible to say the exact form this movement will take.

Other associations for the promotion of the Angora goat and the mohair industries are the National Mohair Growers' Association, founded September 23, 1909, and the Northwest Angora Goat Association, which came into existence January 8, 1910.

SCORE CARD FOR ANGORA GOATS.

There is no official American score card, but the following has been suggested by prominent breeders.

Physical animal 25 per cent, subdivided as follows:	Per cent.
Size and constitution	15
Shape of body, head, horns, ears, etc., deducting for black spots on skin, colored hair, black streaks in hoofs, horns, etc., up to 10 points	10
Fleece 75 per cent, subdivided as follows:	
Must be soft, silken, velvety, with small compact ringlets	30
Must be of eveness in length, density, and growth 1 inch or more per month, which gives weight	20
Freedom from kemp	15
Luster	10
Total	100

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Contribution from the Bureau of Animal Industry, A. D. Melvin, Chief.
April 7, 1914.

POULTRY HOUSE CONSTRUCTION.

By ALFRED R. LEE,
Junior Animal Husbandman in Poultry Investigations, Animal Husbandry Division.

POULTRY HOUSES AND FIXTURES.

This article explains the essential principles of poultry-house construction, showing pictures of houses and fixtures which have given satisfaction in various sections of the country, with their plans and specifications; and contains hints on construction which will assist the poultryman in planning and erecting his buildings.

ESSENTIALS IN POULTRY HOUSES.

The prime essentials in poultry houses are fresh air, dryness, sunlight, and space enough to keep the birds comfortable. No particular style of house is peculiarly adapted to any section of this country. A house which gives satisfaction in Maine will also give good results in Texas or California, but it is preferable to build more open and consequently less expensive houses in the South than in the North. The best site for the poultry house depends principally on the local conditions. The location should have good water and air drainage, so that the floor and yards will be dry, while the house should not occupy a low pocket or hollow in which cold air settles, and it should be situated for convenience in management and adapted to the available land. Wherever possible a southern or southeastern exposure should be selected, although this is not essential if there is any good reason for facing the house in a different direction.

Poultry can be raised successfully on any well-drained soil. A light loam, which will grow good grass, is well adapted for this purpose; while a very light, sandy soil, through which the water leaches freely, will stand more intensive poultry conditions, but most of the green feed for the fowls kept on such a soil will have to be purchased. A heavy clay or adobe soil is not as well adapted to poultry raising, as such land does not drain readily and it is much more difficult to keep the stock healthy. Long stationary houses, or the intensive system,

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NOTE.—This bulletin gives practical instruction for locating and constructing poultry houses. It is adapted for general circulation.

saves steps, but it is easier to keep the birds healthy and to reproduce the stock under the colony system where the birds are allowed free range. Breeding stock, and especially growing chickens, should have an abundance of range, while hens used solely for the production of market eggs may be kept on a very small area with good results. The colony house system necessitates placing the houses, holding about 100 hens, from 200 to 250 feet apart, so that the stock will not kill the grass. The colony system may be adapted to severe winter conditions by drawing the colony houses together in a convenient place at the beginning of winter, thus reducing the labor during these months.

YARDS AND FENCES.

Fences, dividing the land into yards, increase the cost of equipment, labor, and maintenance, and there should be as few fences as possible, as land can be cultivated and kept sweet more easily if not fenced, and the value of fresh, sweet land for poultry can hardly be overestimated. A grass sward can be maintained on good soil by allowing 200 to 250 square feet of land per bird (217 or 174 birds to the acre), while more space is necessary on poor or light land. A larger number of fowls are usually kept to the acre where double yards are used and the land is frequently cultivated. Plymouth Rocks and the heavy meat breeds in small yards require fences 5 to 6 feet high, while a fence 6 to 7 feet high is necessary for Leghorns. The upper 2 feet of the fence for the latter may be inclined inward at an angle of 30 degrees, or a strand or two of barbed wire may be used on top of the regular wire to help keep them confined, while it is sometimes necessary to clip the wing feathers of one wing of those birds which persist in getting out. It is not advisable to use a board or strip along the top of the fence, as hens will often fly over one so constructed.

Posts may be set or driven into the ground. They should be set 8 to 10 feet apart with common poultry netting, or 16 to 20 feet with woven wire. Corner posts should be about 8 inches in diameter, and be set 4 feet in the ground, while intervening posts may be 4 or 5 inches in diameter and set 3 feet in the ground. That part of the post which is set in the ground may be charred or treated with some wood preservative to advantage, while corner posts should be firmly braced or set in cement.

CONSTRUCTION OF POULTRY HOUSES.

A house constructed for the convenience of the attendant will have enough cubic air space provided 2 to 5 square feet of floor space is allowed per fowl. Fresh air should be secured by ventilation rather than by furnishing a larger amount of cubic air space than is required for the convenience of the attendant. The necessary amount of floor space depends upon the system, on the size of the pens, the weather conditions, and the size of the birds. More birds can be kept on a small floor area under the colony than on the intensive system, where the colony system is used in a mild climate and the hens have free range throughout most of the year. Colony houses holding from 30 to 75 hens are about as large as can be easily moved, but larger numbers may be kept in one flock in a long house. Flocks of from 60 to 150 are well adapted to the average conditions for the production of market eggs. Large numbers require less labor, fewer fences, and a lower house cost than small flocks, but there is a greater chance for disease and the individual hen receives less attention. The cost of housing poultry depends upon many conditions, such as price of lumber, style of house, amount of floor space allowed per bird, etc. Substantial poultry houses can be built for from 80 cents to $1.60 per head, including labor. The cost of material per head will vary from 50 cents to $1.

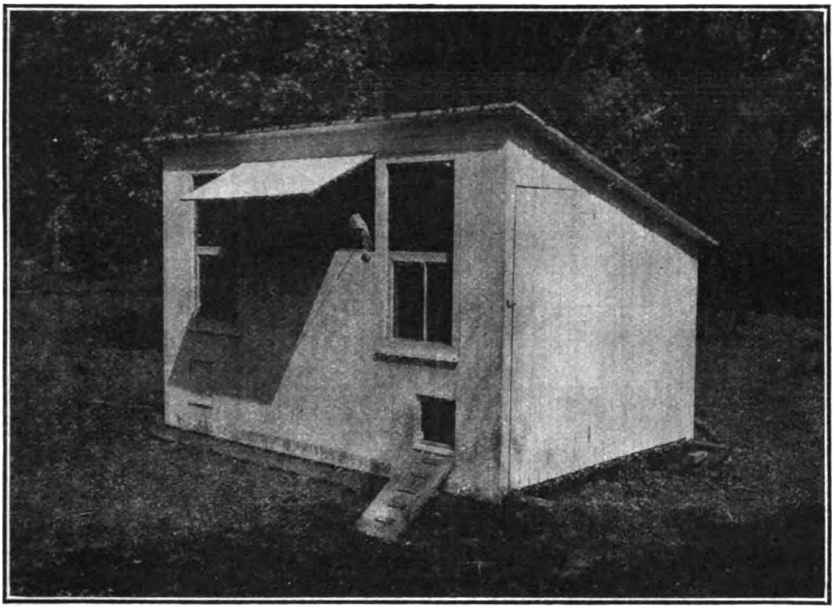


FIG. 1.—Colony house used at Government Poultry Farm, Beltsville, Md.

ROOF AND FRONT.

The roof is the most expensive but a most important part of the poultry house, and should be water-tight. Shingle roofs should have a one-third pitch, while those covered with paper or metal may have a less pitch, or be almost flat; however, the greater the slope the longer the life of the roof. Different types of roofs and the comparative amount of surface to be covered are illustrated in figure 5. The shed or single-slope roof is adapted to houses up to 16 feet in

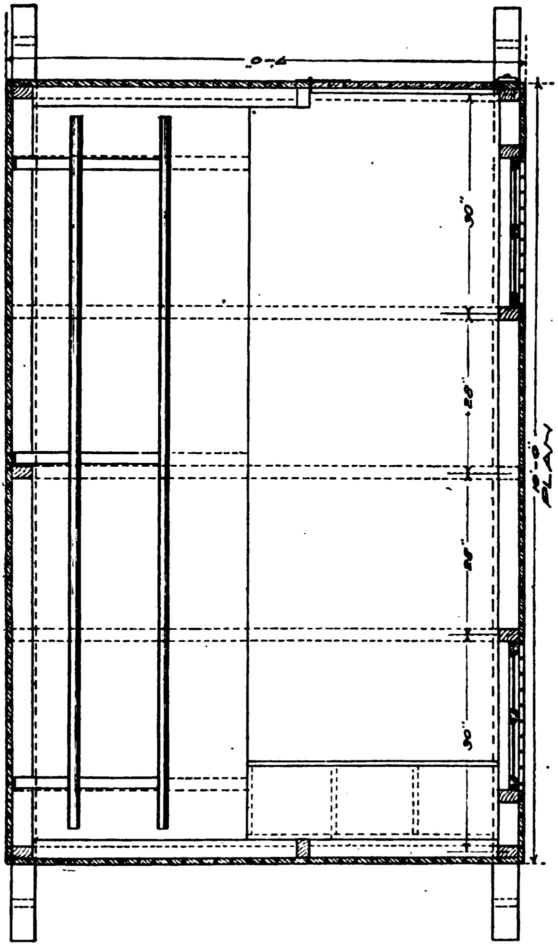
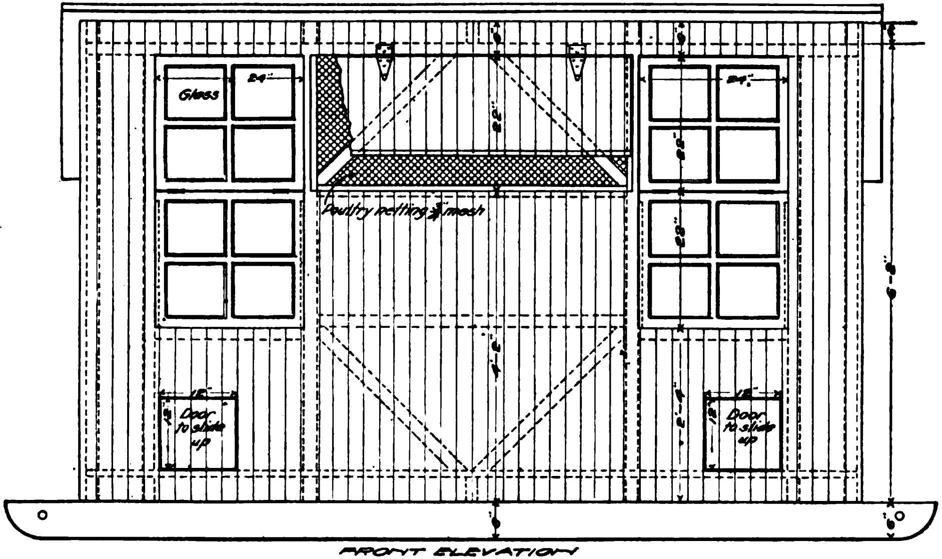


FIG. 2.—Floor plan of colony house used at Government Poultry Farm, Beltsville, Md. Capacity, 25 hens.

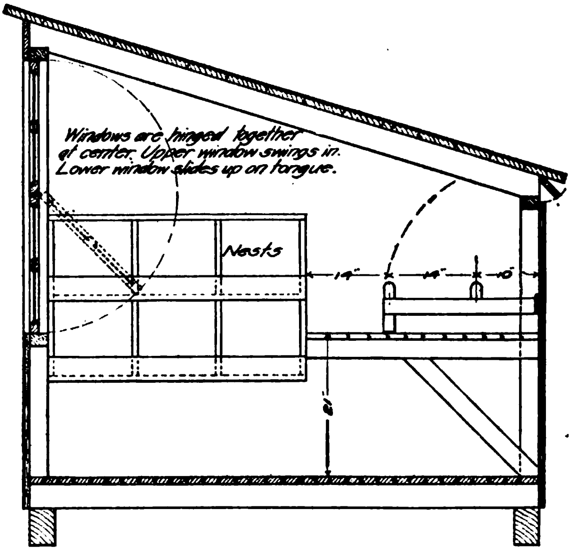
BILL OF MATERIAL FOR COLONY HOUSE

USE	SIZE	Nº OF PIECES	LENGTH FEET	BOARD MEASURE
Sills (runners)	4"x6"	2	12'	48'
Joists	2"x4"	3	14'	28'
Studs & braces	2"x3"	13	12'	78'
Rafters	2"x4"	3	16'	32'
			Total	186'
7/8" Matched flooring (floor & sides)				340'
7/8" Sheathing, surfaced one side				100'
Roofing paper, 1 roll.				
Windows, hardware, etc.				

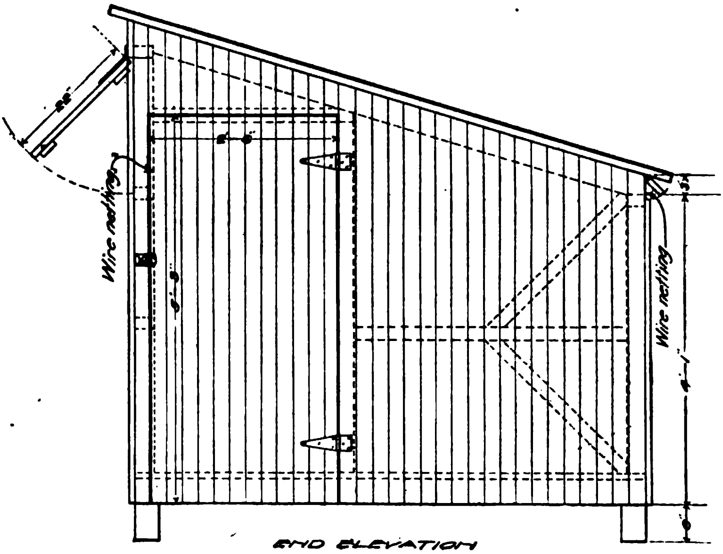


Note: Sills (runners) 4"x6"; joists & rafters 2"x4"; plates studs & braces 2"x3"; siding & flooring 7/8" tongue & groove material and roof 7/8" material covered with roofing paper.

FIG. 3.—Front elevation of colony house used at Government Poultry Farm, Beltsville, Md. Capacity, 25 hens.


Windows are hinged together at center. Upper window swings in. Lower window slides up on tongue.
Nests
14"
14"
10"
21"

CROSS SECTION



END ELEVATION

FIG. 4.—Cross section and end elevation of colony house used at Government Poultry Farm, Beltsville, Md. Capacity, 25 hens.

width. It is one of the easiest styles to construct. It allows a high front to the house, and furnishes a northern slope for the roof on which roofing paper will last longer than on a roof which faces the south. The combination and semimonitor roofs are adapted for buildings from 16 to 24 feet wide, while either of these styles, or the monitor and the gable roof, may be used for wider buildings. The combination roof on a house over 16 feet wide gives the best head room at the least cost, reduces the amount of surplus air space, and gives a neat appearance to the buildings; while the semimonitor and monitor types are best for wide houses which have a central alley, particularly brooder houses. The semimonitor house usually faces south, while the monitor type of roof is frequently used on buildings facing east or west. The gable roof is used extensively for two-story buildings, for brooder houses, and for incubator cellars. This style of roof is usually ceiled at or slightly above the eaves, or the gable may be filled with straw or some kind of absorbent material, which tends to keep such houses dry and warm. The A-shaped roof is used for growing coops and colony houses which, with a wall 18 inches high, provides a large amount of floor space with a minimum amount of lumber, but increases the roof surface, which is the most expensive part of the house.

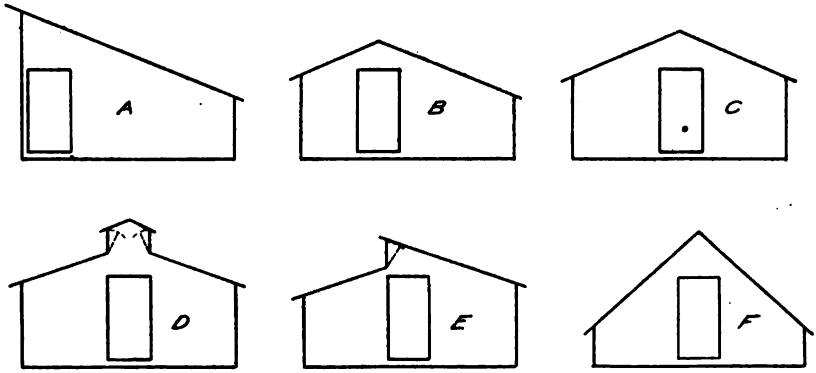


FIG. 5.—Types of roofs for poultry houses. *A*, shed; *B*, combination; *C*, gable; *D*, monitor; *E*, semimonitor; *F*, A-shaped.

A large amount of glass in the front of the house makes it warm during the day and cold at night, as glass radiates heat very rapidly. Unbleached muslin, or a light weight of duck cloth, is used for curtains in the fronts of poultry houses. This cloth should be thin enough to allow a slow circulation of air without a draft, which object is defeated by using too heavy a grade of duck or by oiling or painting the cloth. The front of the house should be high enough so that the windows or openings will allow the sun to shine well back during the winter. The depth which the sun's rays shine onto the floor of

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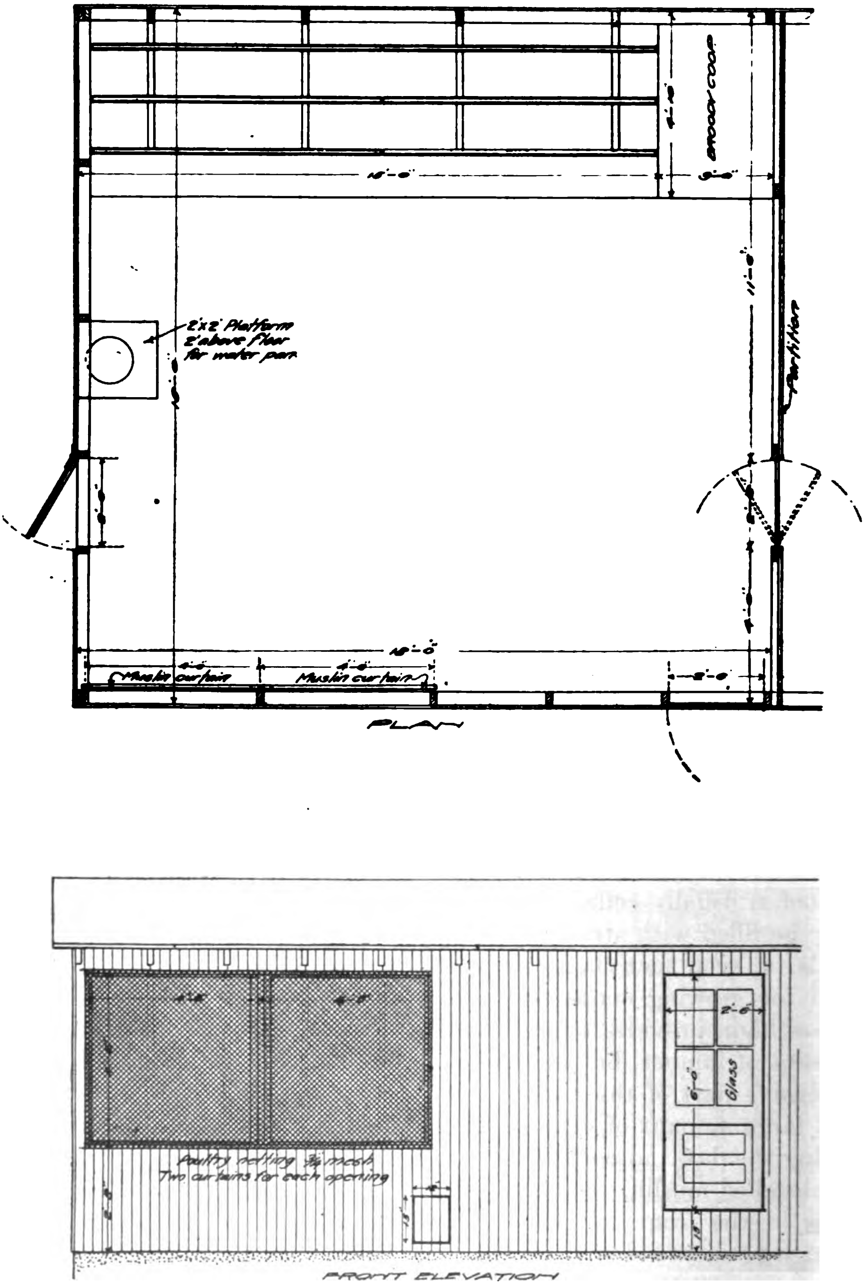


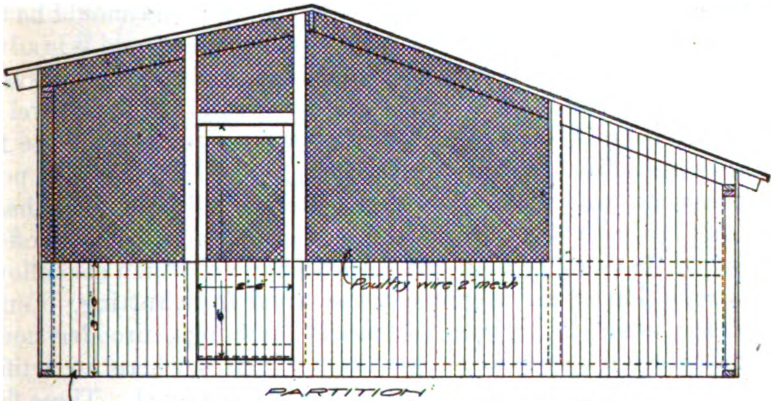
FIG. 6.—Floor plan and front elevation of laying house used at Government Poultry Farm, Beltsville, Md. Capacity, 500 hens.

BILL OF MATERIAL FOR
LAYING HOUSE 18'X 108'

USE	SIZE	NO OF PIECES	LENGTH FEET	BOARD MEASURE
Sills	2"x4"	30	12'	240'
Plates	2"x4" doubled	44	12'	352'
Ties for rafters	1x5"	30	16'	220'
Rafters	2"x6"	56	14'	784'
Rafters	2"x6"	56	10'	560'
Studs	2"x4"	38	12'	304'
Studs (front)	2"x4"	28	8'	150'
Roosts	2"x3"	36	8'	144'
			Total	2754'
Sheathing surfaced one side for roof				2860'
Matched flooring for walls partitions & droppings board				3200'
Boards planed both sides for nests				300'

340 Running feet of 1"x3" furring for curtain frames.
300 Sq. ft. of 3/4" mesh wire for front.
300 Sq. ft. of 2" mesh wire for partitions.
350 Sq. ft. of muslin cloth for curtains.
Prepared roofing paper to cover 2700 sq. ft.
8 Outside doors.
Hardware (hinges, nails, staples, etc.)

Cement wall or posts (either cement or wood) for foundation. If posts are used the sill should be 4"x4" instead of 2"x4" thus doubling the number of feet (board measure) required for sills.



Note: All partitions like this except every other one which is boarded up to roof.

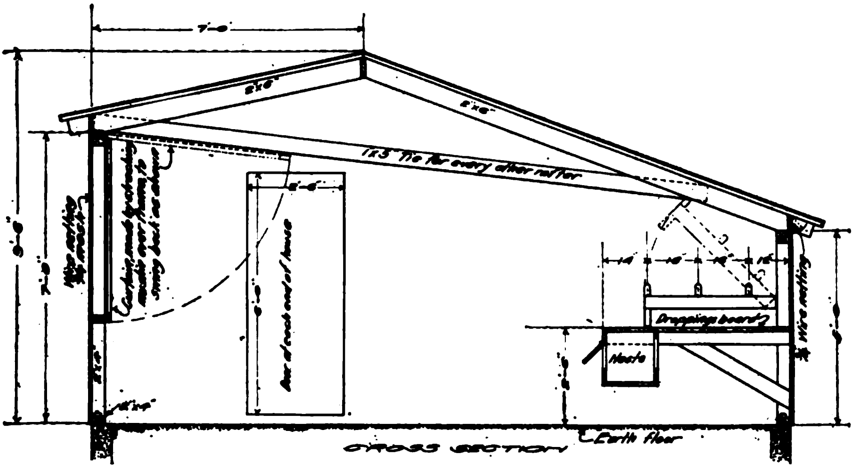


FIG. 7.—Partition and cross section of laying house used at Government Poultry Farm, Beltsville, Md. Capacity, 500 hens.

the house in the vicinity of Washington, D. C. (latitude 40° N.), on January 1, is given in the accompanying table.

Top of windows.	Depth of sun.	Top of windows.	Depth of sun.
Ft. in.	*Ft.*	*Ft. in.*	*Ft.*
3 6	8	6 2	14
4 5	10	7 1	16
5 4	12	7 11	18

FLOOR.

The best kind of a floor depends upon the soil and the use of the house. On light, sandy, well-drained soils a dirt floor is satisfactory, especially for small or colony henhouses. Such floors should be from 2 to 6 inches higher than the outside ground surface, and it is advisable to renew them each year by removing the contaminated surface down to clean soil, and to refill with fresh sand or fine gravel and earth. A board floor is generally used where the level of the floor in the house is from 1 to 3 feet above the ground surface and in portable houses on land which is not well drained. Board floors harbor rats and rot quickly, and should be raised some distance off the ground so that cats or dogs can get under them, which also allows a free circulation of air to prevent the wood from rotting. Cement floors are adapted to long permanent buildings, brooder houses, incubator cellars, and to all permanent houses where an artificial floor is required and can be built on the ground level. These floors are easy to clean, very sanitary, rat proof, and comparatively inexpensive, if one has a supply of gravel or sharp sand.

Bill of material for colony growing coop.

Use.	Size.	Number of pieces.	Length.	Board measure.
	Inches.		*Feet.*	*Feet.*
Sills (runners)	3 by 4	2	8	16
Joists	2 by 4	2	10	14
Studs and braces	2 by 3	8	12	48
Rafters	2 by 4	3	12	24
Total				102
⅞-inch matched flooring (sides and floor)				175
⅞-inch sheathing surfaced on one side (roof)				30
Roofing paper, one-half roll.				
Hinges and hardware.				

PARTITIONS.

The lower 3 feet of all partitions may be solid, entirely across the pen, or solid partitions across the houses may be made every 30 or 35 feet, depending upon the length of the house. Solid partitions closer than this are unnecessary and interfere with free circulation of air in warm weather.

ROOSTS AND DROPPING BOARDS.

The interior fixtures of the pens should be simple, portable, and inexpensive. Roosts are usually placed next to the end or back

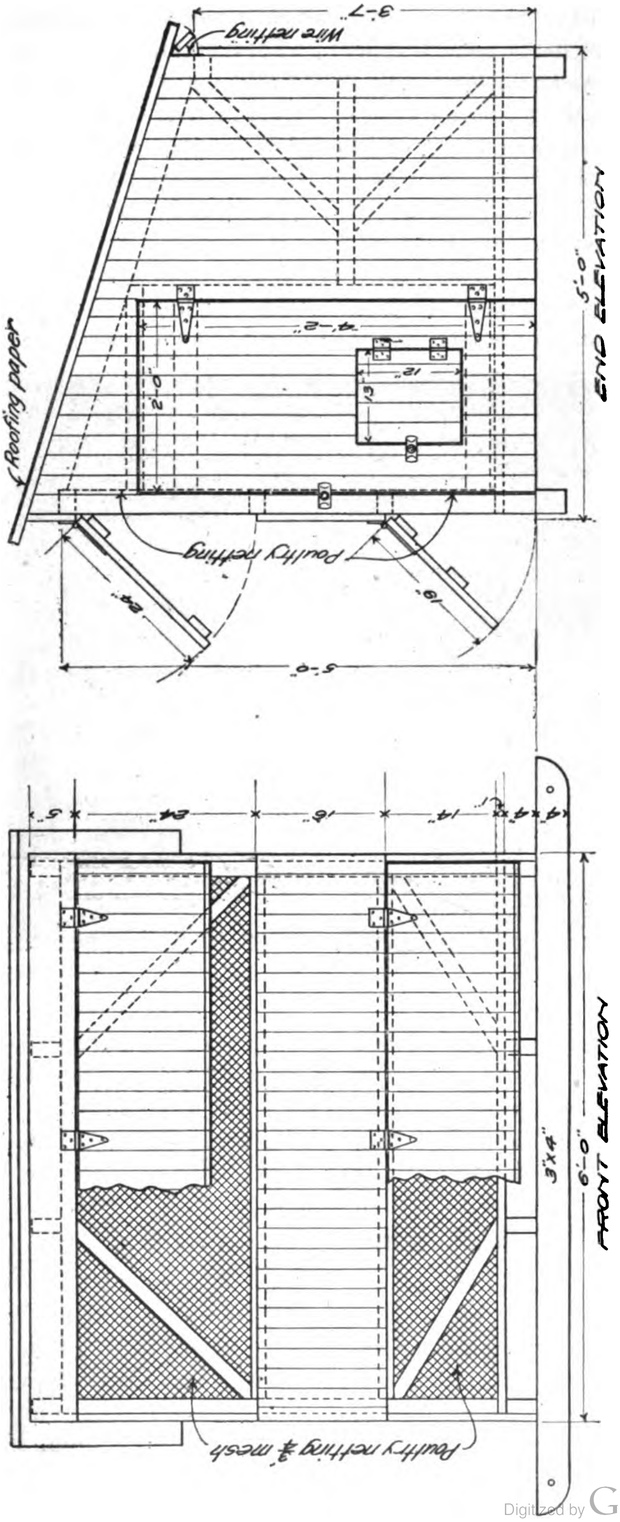


FIG. 8.—Colony growing coop used at Government Poultry Farm, Beltsville, Md.

walls, 6 to 10 inches above the dropping boards, while the latter are from 2 to 2½ feet above the floor. They should all be on the same level, otherwise the birds will crowd and fight to get on the highest roost. Scantling 2 by 3 inches or 2 by 4 inches, with the upper edges rounded off, makes good roosts with either the wide or narrow surface up. Allow 7 to 10 inches of roost space per fowl, according to the size of the birds. Roosts should be placed about 15 inches apart, but the outside ones may be within 10 inches of the edge of the dropping boards.

Nests may be placed under the dropping boards, on the partition walls, or in any convenient place where they do not take up floor space, and should be arranged so that the birds can get into them easily. They should be 12 to 14 inches square and 12 to 16 inches high, with a strip about 4 inches high on the open side to retain the nesting material. Provide one nest for every four or five hens. Trap nests are essential in any careful breeding work, such as pedigree breeding, or the breeding of exhibition poultry.

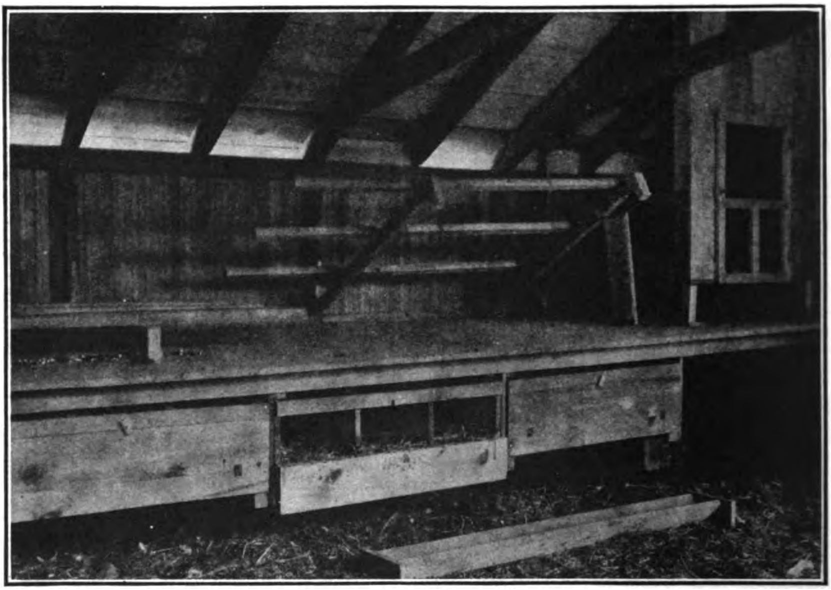


FIG. 9.—Interior of pen in laying house used at Government Poultry Farm. Roosts, dropping board, and nests.

KINDS OF MATERIAL USED FOR BUILDING.

Houses made entirely of solid concrete are cold and damp, but concrete blocks may be used with good results. Hollow tile makes a very good poultry house, and it can be bought in some sections at a price which compares favorably, considering its durability, with wood. This construction is well adapted to incubator cellars and brooder houses, or to any buildings requiring double walls and good insulation.

All kinds of wood are used in building poultry houses, and any durable lumber which is available for that purpose may be used. The lumber which is to be used for the outside construction should be well seasoned, otherwise the shrinkage will leave cracks in the walls. Hemlock, spruce, western white pine, and Virginia pine are commonly used for sheathing in the North, hard pine in the Gulf States, and redwood or Oregon pine on the Pacific coast. Redwood, cypress, and white pine are the best materials for siding, while clear spruce, Oregon, Georgia, North Carolina, and Virginia pine are also used. Chestnut is used locally for sheathing and siding in some parts of New England and the Alleghenies, while local pines of different species are available for rough lumber in many sections. Spruce, white pine, northern yellow pine, Georgia, Virginia, and North Carolina pine are used for light framing (studs, rafters, sills, plates, purlins, etc.). Oregon and Georgia pine are used for sills and runners. The best shingles are made of redwood, cypress, and cedar; and white pine is also used. Asbestos shingles are quite durable, but more expensive than wooden ones. Cedar, chestnut, redwood, cypress, and locust make the best posts. Second-hand lumber or lumber from large packing or piano boxes can be used in building small poultry houses. Lumber comes in even lengths, usually 10, 12, 14, and 16 feet long, and if second-hand lumber is to be utilized, it may be advisable to plan the house according to the length of the lumber. Care should be taken in ordering a bill of lumber to secure lengths which will cut to the best advantage in building.

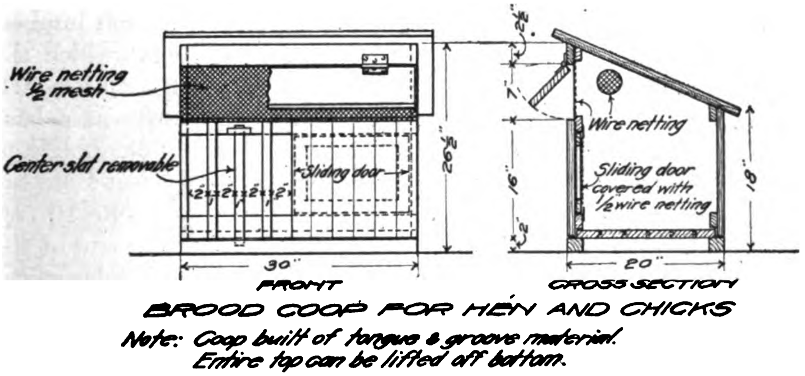

Wire netting ½ mesh
Center slat removable
2" 2" 2" 2"
Sliding door
26½"
30"
FRONT
2½"
7"
16"
2"
Wire netting
Sliding door covered with ½ wire netting
18"
20"
CROSS SECTION
BROOD COOP FOR HEN AND CHICKS
Note: Coop built of tongue & groove material.
Entire top can be lifted off bottom.

FIG. 10.—Brood coop for hen and chicks, used at Government Poultry Farm.

FRAMEWORK OF THE BUILDING.

The sills are placed on posts, stones, or cement supports, or directly on cement walls. Wooden floors should be from 10 to 18 inches above the ground, while cement floors are built directly on it, but the site should be elevated enough so there is good drainage away from the building. Posts should be from 6 to 8 inches in diameter, placed 6 to 8 feet apart and set 2 to 3 feet in the ground or below the frost level, which varies with the locality. Sills may be 2 by 4, 4 by 4, and 4 by 6 inches, depending upon the size and construction of the building; 2 by 3 or 2 by 4 inches are heavy enough for colony houses or those of light, single-wall construction, which are not over 10 or 12 feet deep and 4 to 7 feet high. Sills 4 by 4 inches are used for larger buildings and for houses with double walls. Runners 3 by 4 or 4 by 6 inches are used as sills for portable houses, as the latter require heavy framework. Sills 4 by 6 inches are used in two-story henhouses or other large poultry buildings, and should be set on edge unless on a cement or stone wall, when a lighter sill may be used which is set flat. The posts or supports must set closely together if light sills are used. Floor joists may be 2 by 4, 2 by 6, or 2 by 8 inch lumber, their size depending somewhat on the amount of weight which the floor has to sustain, and should be set from 16 to 20 inches apart. Fix one line or side of the proposed house, and with this as a base locate the other corner posts by using the 6, 8, and 10 foot combination, measuring 6 feet from the corner of the fixed line and 8 feet from the same corner at right angles, which point is fixed by a rule 10 feet long running from the 6-foot mark of the fixed line to the end of the 8-foot line, thereby making a square corner. A triangle whose sides are 6, 8, and 10 feet long, respectively, contains a right angle opposite the hypothenuse or diagonal side. For small buildings drive a stake at the selected corner for the house, and nail a straightedge to this stake at the desired height of the posts or floor, using a spirit level on this straightedge to mark the posts at the same level. A transit is generally used in laying out large buildings.

The studding or uprights are placed on the sill and should be set plumb with a spirit level and be well braced until sheathed. Sills are halved or spliced and nailed together at the joints or ends. The studding is toenailed to the sills, while the plates are spiked to the top of the studding. Studding is set 2 to 4 feet apart on the rear walls and ends of poultry houses and is placed to fit the windows, curtains, and doors in the front and ends. Less studding is required if the building is boarded up and down rather than horizontally, as in the former case only a few studs with cross-studding or ties are required. The studs should be placed so that the lumber will cut to good advantage, as lumber usually comes in even rather than odd lengths. Studs 2 by 3 or 2 by 4 inches are commonly used, the former for small or colony houses and the latter for larger buildings. Plates are made of 2 by 4 inch scantling or 2 by 4 inch scantling doubled and spiked together and are usually laid flat on the top of the studs, while the corner studs may also be doubled. Rafters may be of 2 by 4, 2 by 5, or 2 by 6 inch lumber; the first is used only in light buildings; the first and second in buildings where the rafters are not over 14 feet long; and the latter in climates where the roofs must sustain much weight of snow. It is advisable to use a purlin in buildings where rafters are over 14 feet long. Purlins are usually made of 2 by 6 or 2 by 8 inch material set on edge. They are placed lengthwise of the house above halfway between the front and back walls and make a support for the rafters. A ridge board may be placed between the ends of the rafters at the apex of the house to keep the ridge straight and even. Collar beams or crossties 1 by 6 or 1 by 8 inches are used to connect and strengthen the front and rear rafters on two-pitch, gable, or combination roofs. They should be placed as low as possible on the rafters, so as to stiffen the frame, but not to interfere with head space. One pair of rafters may be set in position and the rest marked from these, or a square may be set on the rafter, using the inches on the square to correspond to the feet in the slope of the roof and the rafters marked from the angle thus obtained, so that they will fit correctly. Rafters should only be notched or cut enough to fit tightly where they rest on the plates; not over 1 inch, as deep notching weakens them. They are usually placed 2 or 2½ feet apart from center to center, so that the sheathing may be used with the least amount of waste.

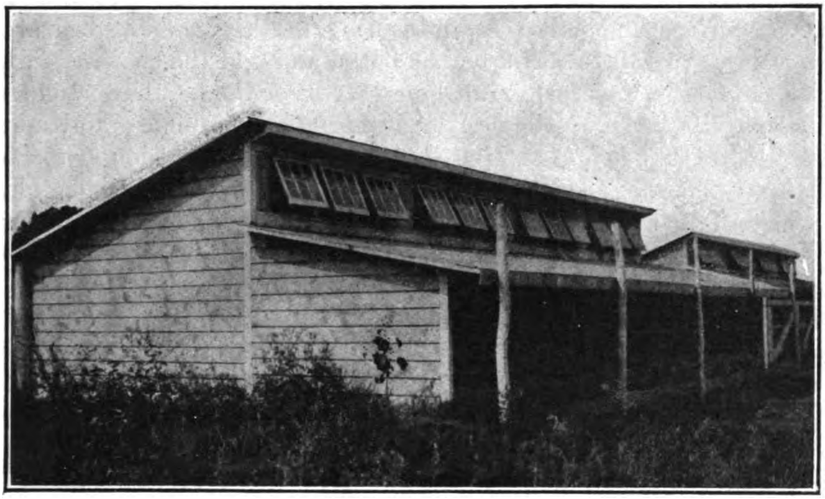


FIG. 11.—A semimonitor style of laying house.

CONSTRUCTING FLOORS.

Wooden floors are usually made of matched flooring and are generally doubled in cold climates to make them tight and warm, in which case the lower layer of boards is usually laid diagonally to strengthen the floor. Floors of one thickness give good satisfaction in the South and in growing houses. Three-quarter-inch mesh wire may be used under wooden or dirt floors to keep out rats. In making concrete or cement floors and walls, select Portland cement of known reputation, which should be kept in a dry place; use clear, coarse, sharp sand or gravel which does not contain over 5 per cent of clay or silt and crushed stone or gravel one-fourth to 2 inches in diameter. The gravel should be screened through a one-fourth-inch mesh wire screen and the coarse particles used as stone, while the material which passes through the screen is sifted through a 40-mesh wire screen in order to separate the sand, and any material which goes through the 40-mesh wire is thrown away. A mixing board with a smooth surface and a box for measuring the sand and gravel are necessary. Spread the sand on the board and add the cement; mix these thoroughly together; add three-fourths of the required amount of water, and then the gravel or stone; mix thoroughly and add water to the dry spots, making the mixture just wet enough to be jellylike. Thorough mixing is very essential, as the mortar should completely coat all particles of the mixture. Only enough water should be added so that when the concrete is tamped on laying the water will nicely flush the surface.

Good concrete mixtures may be made of 1 part (2 bags) cement, 2 parts sand, and 4 parts stone or gravel, which will take about 10 gallons of water in mixing; or 1 part (2 bags) of cement, 2½ parts of sand, and 5 parts of stone or gravel, which is mixed with about 12½ gallons of water. If natural gravel or sand is used without sifting, make the concrete of 1 part (2 bags) of cement and 4 parts of gravel, mixed with about 10 gallons of water, or of 1 part (2 bags) of cement and 6 parts of gravel with about 12½ gallons of water. A coating of clear cement or of 1 part cement and 1 part sand may be added to give a smooth finish to the floor. Most concrete or cement floors are damp and cold and, therefore, must be quite heavily covered with litter. A 4-inch foundation of cinders, broken stone, or gravel, which should be made firm by tamping, may be laid as a foundation for the cement floor, making the concrete 2½ to 3 inches thick. A layer of tarred building paper, which is lapped and cemented with tar at the seams, may be laid between the stone foundation and the concrete. This construction prevents moisture from coming through the earth and concrete, which makes the floor damp. Cement floors should always be built from 4 to 6 inches above the ground level to insure good water drainage. Concrete floors built on the earth are made from 3 to 4 inches thick, which is covered with a layer one-half to 1 inch thick of the finishing coat described above.

MATERIAL FOR COVERING WALLS.

The walls of most poultry houses in the North are built of sheathing and covered with specially prepared paper, siding, clapboards, or shingles. Sheathing paper is generally used on walls and roofs which are to be covered with shingles. A wall made of siding placed directly on the studs makes a satisfactory henhouse in the South. Another method of making a cheap, tight wall, used extensively in colony house construction, is to use boards 10 to 12 inches in width placed vertically with the cracks covered with battens 2 to 3 inches wide. Battens are usually 1 inch thick, and may be either nailed or screwed to the house. One-inch matched lumber is used extensively in poultry house construction, and makes a very satisfactory wall without any other covering than paint. Narrow lumber, 2½ to 6 inches wide, is usually used for this purpose, as wide boards are apt to shrink and warp, which results in cracks in the walls. The lowest board on the walls should extend into the ground below the sill to make a tight joint, which should also be made at the eaves where it may be secured either by cutting the rafters off even with the rear wall and covering this joint with good roofing paper, or by filling in the space between the rafters with boards or muslin curtains. A 4 or 6 inch board may be used on the rafters, allowing it to extend out 2 to 4 inches beyond the rear wall, or a double course of shingles may be laid and allowed to extend in this same manner. Sheathing should be laid so as to break joints in order to strengthen the building, while siding is usually laid working from the bottom upward. A shutter may be placed

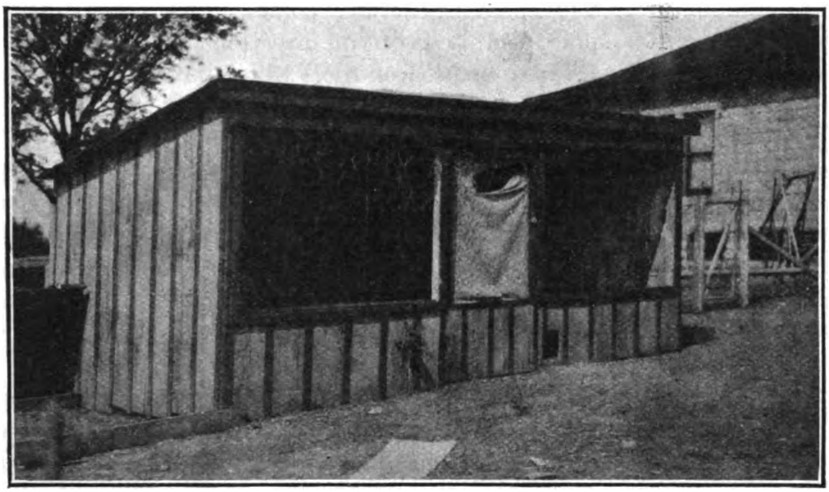


FIG. 12.—A laying house used in Georgia.

just under the eaves on the outside of the rear wall for summer ventilation. The essential point is to have a rear wall which is tight near the roosts to prevent drafts from striking the birds.

MAKING THE ROOF.

Specially prepared paper or shingles laid on sheathing may be used for covering the roof. Roofing papers are used very extensively for poultry houses at the present time, and in many places are replacing shingles. As a rule, the former are cheaper and easier to lay, while they can be laid on a much flatter roof than the latter. One or two-ply paper is usually used on the sides, and one, two, and three ply paper on the roofs, although this varies with different styles and grades of manufacture. This paper generally comes in rolls or squares, which cover 100 square feet, and contain directions and materials for use in laying. Paper may be used on roofs which have a slope or rise of 1 or more inches to the foot. Sheathing for paper roofs must be planed on one side and laid tightly to present a smooth surface for the roofing paper, while sheathing paper is often used between the sheathing and the roofing paper. Shingles may be laid from 4 to 5 inches to the weather on roofs which have one-third or more pitch, which is a rise of 8 or more inches to the foot, or one-third of the span of a gable roof. Cedar and cypress shingles are usually laid 5 to 6 inches to the weather on walls or on roofs with one-third pitch, but are not generally used on roofs which have a rise of less than 8 inches to the foot. One thousand shingles, or 4 bundles of cedar shingles, are the equivalent of 1,000 shingles 4 inches wide. In shingling, commence at the eaves or lowest edge by laying a double course, while the rest of the layers are of single courses. They are laid either to a chalk line, which is fastened at the right points at either edge of the roof and snapped to make a mark for the lower edge of the tier of shingles, or to a straight-edged stick. Each shingle is nailed with two either 5 or 6 penny nails, driven 7 to 8 inches from the butt, depending upon the lap, so that the heads of the nails will be covered by the next course. One thousand cedar shingles laid 4½ inches to the weather will cover about 125 square feet, depending on their size. Shingles may be laid on narrow sheathing 3 to 5 inches wide, or on common sheathing, which is spaced from 1 to 2 inches apart to allow the roof to dry out quickly, and they should break joints at least 1 inch and as much more as possible.

ESTIMATING THE AMOUNT OF MATERIAL REQUIRED IN BUILDING.

Lumber comes in even lengths usually 10, 12, 14, and 16 feet long. It is figured at so much per 1,000 feet board measure, which means the number of square feet which the material would cover if it were 1 inch thick. To compute board measure, divide the area of the cross section of the stick of lumber in inches by 12, and multiply by the length in feet. The accompanying table shows the number of feet board measure, in lumber from 6 to 16 feet long, with a cross section varying from 4 to 16 inches.

Table of board measure.

Length.	Area of cross section.					
	4 inches.	6 inches.	8 inches.	10 inches.	12 inches.	16 inches.
	Board measure.					
Feet.	*Ft. in.*	*Feet.*	*Ft. in.*	*Ft. in.*	*Feet.*	*Ft. in.*
6	2 0	3	4 0	5 0	6	8 0
8	2 8	4	5 4	6 8	8	10 8
10	3 4	5	6 8	8 5	10	13 4
12	4 0	6	8 0	10 0	12	16 0
14	4 8	7	9 4	11 8	14	18 8
16	5 4	8	10 8	13 4	16	21 4

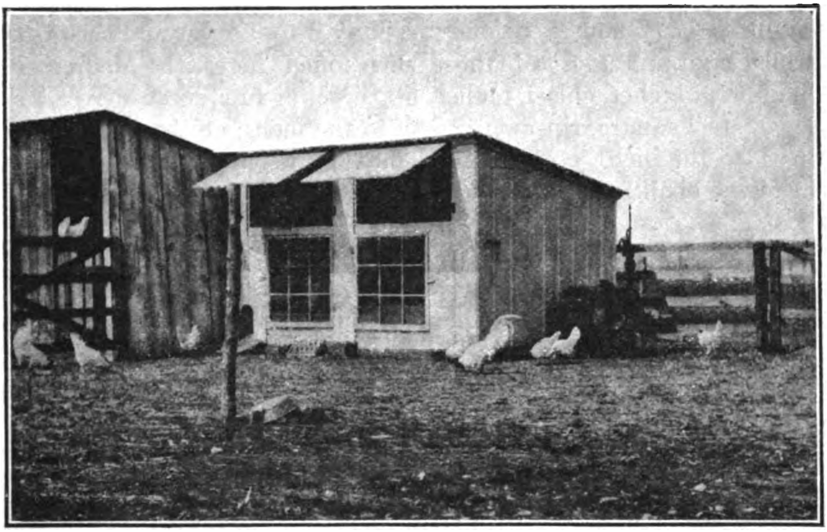


FIG. 13.—A colony house used in Texas.

Boards less than 1 inch thick are usually sold at so much per square foot, the price depending on the thickness of the lumber. Given the dimensions of a simple poultry building, one can work out a general bill of material required for its construction. A working plan of the building should be drawn to a convenient scale, usually one-fourth inch to the foot for poultry houses, showing the ground plan, the front elevation, and the end or a cross section of the house. The bill of material can be worked from this plan.

In estimating lumber allow for waste as follows: Common sheathing add one-tenth for waste, and one-fourth for matched flooring and all kinds of siding. Wire nails are generally preferred in construction as they are easier to use than cut nails, although the latter have greater binding power. Use 10 to 20 penny nails for framing; 8 to 10 penny for sheathing; 6 penny finish or casing nails for clapboarding, and 8 penny for siding. Four penny nails are 1½, 6 penny are 2, and 8 penny are 2½ inches long, etc. It takes about 8 pounds of 5 penny nails to 1,000 shingles; 18 pounds of 6 penny for 1,000 square feet, board measure, of beveled siding; 20 pounds of 8 penny or 25 pounds of 10 penny for 1,000 square feet of sheathing; 30 pounds of 8 penny for 1,000 square feet of flooring, and 15 pounds of 10 penny or 25 pounds of 20 penny for 1,000 feet of studding. Allow one bag of cement for about 13 square feet of concrete floor, adding one extra bag for every 10 running feet of foundation wall. This is estimated for a floor made of 3 inches of a 1–2½–5 mixture of concrete, covered with one-half inch of a finishing coat, containing equal parts of sand and cement.

The following tools will make a fair outfit for use in constructing simple poultry houses, or one may buy a tool chest and set of tools, which contains most of those mentioned herewith: Medium-sized hammer, hatchet, chisel, mallet, brace, set of bits, screw driver, plane, level, steel square, ripsaw (5 teeth to the inch), crosscut saw (8 to 10 teeth to the inch), compass saw, monkey wrench, oilstone, files, pair of pliers, chalk, and a 2-foot rule.

PAINT.

Painting adds greatly both to the appearance and service of all buildings and appliances. One may buy ready-mixed paints, or may purchase paste pigments and oil and mix them. All surfaces should be clean and dry before they are painted. Use a priming coat made of equal parts of paint and linseed oil and cover with one or more coats of paint, which should be thoroughly rubbed into the surface.

WHITEWASH.

Whitewash is the cheapest of all paints and may be used either for exterior or interior surfaces. It can be made by slaking about 10 pounds of quicklime in a pail with 2 gallons of water, covering the pail with cloth or burlap, and allowing it to slake for one hour. Water is then added to bring the whitewash to a consistency which may be applied readily. A weatherproof whitewash for exterior surfaces may be made as follows: (1) Slake 1 bushel of quicklime in 12 gallons of hot water, (2) dissolve 2 pounds of common salt and 1 pound of sulphate of zinc in 2 gallons of boiling water; pour (2) into (1), then add 2 gallons of skim milk and mix thoroughly. Whitewash is spread lightly over the surface with a broad brush.

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FARMERS' BULLETIN
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THE AGRICULTURAL OUTLOOK.

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LIVE STOCK OF THE UNITED STATES.

INTRODUCTION.

The contents of this bulletin relate principally to estimates of the supply of live stock of specified classes on farms in the United States on January 1, 1914, the average farm price per head, and the estimated total value of each class. These estimates are based upon reports and estimates from 22 special field agents, 47 State statistical agents, 1,867 county correspondents, 15,542 township correspondents, and 1,782 special live stock correspondents. The results of these estimates have in every case been compared with the estimates by this bureau for the past three years, with the census of 1910, and with the totals shown by the records of tax assessors in the various States so far as they are available for the past three years. While the totals and averages set forth herein are purely estimates, it is believed that they are as nearly accurate as it is possible to make them without an actual enumeration, such as was made by the Bureau of the Census in 1910. The statistics of farm animals and animal products are admittedly most unsatisfactory. A mass of statistics are available as to receipts and shipments of live stock at some of the great central markets of the West and Middle West, as to the number of animals exported and imported, and as to the average weights and prices quoted at central markets; but aside from the census no accurate statistics as to the number, sex, age, weight, annual increase or decrease, or cost of production, are available from year to year in the United States. Accurate statistics do not exist for the present year as to the number of local slaughtering houses in the United States, the number of meat animals slaughtered therein, cost of slaughtering, or the quantity of meat and by-products pro-

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NOTE.—The next regular report of the Bureau of Statistics (Agricultural Forecasts) will relate to corn, wheat, oats, and barley, and will be issued at 2.15 p. m., March 7, 1914.

duced; nor are statistics to be had yearly of the cost involved in handling meat animals at the great central slaughtering and packing establishments of the West and Middle West. The best information obtainable on the numbers and values of live stock, including meat animals, is that collected decennially by the Bureau of the Census and the annual estimates of the Bureau of Statistics (Agricultural Forecasts) of the Department of Agriculture.

An analysis of the yearly estimates of numbers of live stock in former years by this bureau indicated that there was a tendency to underestimate the correct number, which became apparent when such estimates were checked against the actual enumerations made by the census. This year certain improvements and checks were used in making the estimates, which it is believed will correct this tendency to underestimate.

The estimates for January 1, 1914, indicate that there are 20,962,000 horses and 4,449,000 mules in the United States, an average annual increase of about 1.4 per cent over the number shown by the census of 1910. It is estimated that the average farm price of horses has increased from $108.03 in the census year to $109.32 in January, 1914, and in the case of mules from $120.20 to $123.85 in the same period. On this basis the total farm value of horses is $2,291,638,000 and of mules $551,017,000. The total estimated farm value of these animals is therefore $2,842,655,000, which is an increase of $194,082,000 over the census year and represents an annual increase of wealth from these sources of $48,520,000.

The estimates indicate a slight increase in the number of milch cows since the census year, equivalent to an increase of about one-half of 1 per cent, the estimated number now being 20,737,000. On the other hand, the average farm price of milch cows has increased from $35.29 in the census year to $53.94 in January, 1914, or an increase of 50.7 per cent. On this basis the farm value of milch cows now in the United States is estimated at $1,118,487,000 as compared with their estimated value in the census year of $727,802,000, which is an increase of $390,685,000, or an average annual increase for four years of $97,671,000.

With regard to meat animals, that is, "other cattle," sheep, and swine, the estimates indicate a steady and fairly uniform decrease in the number of cattle and sheep, a slight increase in the number of swine, and a considerable increase in the average farm price of cattle and swine since the census year of 1910. In the case of cattle the number has decreased from 41,178,000 in the census year to 35,855,000 in January, 1914, which is an average annual decrease of 1,330,000, or about 3.3 per cent. In the case of sheep the number is estimated to have decreased from 52,448,000 in the census year to

49,719,000 in January, 1914, which is an average annual decrease of 682,000, or about 1.3 per cent. In the case of swine, the Bureau of the Census reported 58,186,000 on April 15, 1910; on January 1, 1914, it is estimated that there were 58,933,000 in the United States, which is an increase of approximately 747,000, or 1.3 per cent, for the four years.

As compared with the census year of 1910 it is estimated that the farm price of cattle other than milch cows has increased from $19.07 to $31.13, or 63.2 per cent, which is an average annual increase of over 15 per cent. The price of sheep has decreased from an estimated average farm value of $4.12 in 1910 to $4.04 in 1914; swine increased from $9.17 to $10.40 per head in the same period, or 13.4 per cent.

The estimated total number of these three classes of meat animals on January 1, 1914, is 144,507,000 as compared with 151,812,000 in the census year of 1910, or a decrease of 7,305,000 animals; but because of the higher prices the present farm value of these animals is estimated at $1,930,087,000 as compared with $1,534,600,000 in the census year, or an increase in valuation of $395,487,000.

NUMBER AND VALUE OF FARM ANIMALS COMPARED WITH POPULATION.

The report of the last census shows a total population in 1910 of 91,972,000, and estimates an annual increase subsequent to 1910 that would make the population in 1914 equal to 98,646,000. This would indicate that the per capita number of farm animals has decreased since 1910. Relatively to the population there is an accumulated shortage in the four years of 3.5 per cent in the number of horses and 9.8 in the number of mules, or approximately 740,000 horses and 483,000 mules. In the case of milch cows the accumulated shortage amounts to 965,000, or about 4.4 per cent; that is, in order to have the same number of milch cows for every 100 inhabitants in January, 1914, as there were in the last census year would require a total of 21,702,000, which is 965,000 more than the returns from the various correspondents throughout the United States indicate.

With regard to meat animals, our estimates indicate an accumulated shortage since the census year of approximately 19.2 per cent, or 8,536,000 head, of cattle; 11.6 per cent, or 6,509,000 head, of sheep; and 5.2 per cent, or 3,214,000 head, of swine. The indicated total shortage of meat animals since the census of 1910 is therefore approximately 18,259,000 head, or nearly nine beef cattle, seven sheep, and over three hogs for each 100 of the total estimated population in January, 1914. Notwithstanding this tremendous shortage in the number of meat animals in the past four years, a shortage of over 7,000,000 animals, the estimated farm value of the cattle, sheep, and swine, on farms on January 1 was $395,487,000 greater than the estimated value of these animals in the census year of 1910.

SOME CAUSES OF THE SHORTAGE OF MEAT ANIMALS AND INCREASE IN THEIR VALUE.

The shortage of meat animals is probably due to a number of contributing causes, such as the encroachment of farms upon the range territory; absence of a proper range-leasing law permitting economical management and utilization of ranges; the shortage in the corn and forage crop due to the severe drought in Kansas, Nebraska, and Oklahoma in 1913, which caused the farmers in those States to dispose of their meat animals; the increase in the value of land and the increased cost of labor and stock feed, resulting in greatly increasing the cost of production; the decline in stock raising on farms in the East and South because of poor marketing facilities resulting from many local slaughtering establishments having been driven out of business by the competition of the great central slaughtering establishments of the West and Central West; the temptation to sell live stock at the prevailing high prices rather than to continue to carry them with high-priced stock feed, possible loss from disease or accident, and uncertain prices the following year; increased tendency to operate farms under short-term leases, with no incentive to maintain soil fertility through stock raising; possession of leased farms changed at wrong season of year for handling stock economically; enormous losses from cholera in swine; and the competition of higher prices for other farm products. These are some of the causes which are mentioned to account for the apparent shortage in meat animals; but the extent of their influence, singly or combined, is not definitely known. They will undoubtedly be considered by the committee which was recently appointed by the Secretary of Agriculture to investigate the economics of the present meat situation, of which Dr. B. T. Galloway, Assistant Secretary of Agriculture, is chairman, and Dr. H. J. Waters, president Kansas Agricultural College; Prof. C. F. Curtiss, director Iowa Agricultural College; H. W. Mumford, professor animal husbandry, Urbana, Ill.; Dr. A. D. Melvin, chief Bureau of Animal Industry; and Dr. T. N. Carver, director Rural Organization Service, are members.

The large increase in the value of meat animals on farms is probably accounted for by the increased cost of production and the increased consumption or demand arising from the fact that production has not kept pace with the increase in population, and in the case of cattle and sheep has actually declined. This unprecedented increase in the average value of meat animals does not necessarily mean that farmers or stock raisers are making more, if any, profit. On the contrary, the cost of production has probably increased more rapidly than the increase in the selling price of live stock. It is well known that producers of farm products are the last to receive any benefit from higher prices paid by consumers, yet they are prompt to increase production if there is a prospect of realizing better returns. The very fact that there is a present shortage of nearly 19,000,000 meat animals in the United States since the census of 1910 indicates clearly that the business is not profitable to producers; otherwise every farmer and stock raiser in the country would have increased his herds of meat animals.

It should also be borne in mind that the estimated average value of meat animals shown in this bulletin is their value on the farm, and not the wholesale or retail value. The farm value, or average price received on farms, is much less than the wholesale prices, which in turn are considerably less than the retail prices to consumers. Just what the difference is between the price at the farm and the cost to the ultimate consumer is not definitely known, partly because the animals sold from the farm lose their identity in the process of manufacture into meat which is purchased by the consumer. The total cost to the consumer is made up of the cost of production of the live stock (farm price), the cost of marketing and transportation of the live animals, the cost of manufacture into various kinds of meats, and the cost of marketing and distributing the manufactured products to the consumer. This is an immense business in itself and the indications are that the profits are correspondingly large to every one concerned, between the original producer and the ultimate consumer.

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ESTIMATES OF FARM ANIMALS.

CATTLE OTHER THAN MILCH COWS.

NUMBER.

The estimated munber of cattle on farms other than milch cows January 1, 1914 was 35,855,000. The number enumerated in the census of 1910 for April 15 was 41,178,000, from which number there was an unbroken decline year by year to 1914. The decline from the census number is 12.9 per cent, and from the number for 1913, 0.5 of 1 per cent.

VALUE.

In estimated average farm value per head, cattle other than milch cows have made an enormous gain since 1910. The average for January 1, 1914, is $31.13, all ages being included in this average. The average for January 1, 1910, as established by this bureau, was $19.07; for the same month 1912 it was $21.20; and for 1913, $26.36. The increase for 1914 is $4.77, or 18.1 per cent, over the average price for 1913, and $12.06, or 63.2 per cent, over the average price for the census year 1910.

In consequence of the extraordinary increase in the farm value per head of cattle other than milch cows, the total value of this class of animals has increased in a large degree from 1910 in spite of a diminished number. The total value of this class of animals for 1910, established by multiplying the number of animals as determined by the census by the average value per head as determined by this bureau, was $785,261,000; the total value for January 1, 1912, as established entirely by this bureau, was $790,064,000; for 1913, the total estimated value was $949,645,000, a gain of 20.9 per cent over 1910; and the value for January 1, 1914, is $1,116,333,000, a gain of 42.2 per cent over 1910, of 41.3 per cent over 1912, and of 17.6 per cent over 1913.

A tabular statement of the number of cattle on farms other than milch cows and their value per head and total value, with details for the States, may be found in Table 12.

CAUSES OF DIMINUTION OF NUMBER.

The diminution of cattle other than milch cows on the farms of the United States in 1914 as compared with 1913 was caused mainly by the high prices of feed, the drought of the summer of 1913 extending from New England westward to the Rocky Mountains, and by the high prices at which the cattle of this class, bad as well as good, could be sold. West of the Missouri River so deficient were the corn crop and summer forage that a large portion of the cattle were hurriedly and permaturely sold at prices much lower than farmers paid for cattle in the following autumn when they began to restock their pastures. The price of corn rose so high in the autumn of 1913 as to make the profitable feeding of cattle for beef unpromising. In some parts of the drought area, bankers who had advanced money to farmers for feeding beef cattle were afraid that feeding would be unprofitable and forced farmers to sell prematurely. In March, 1913, a blizzard killed many thousands of cattle in Nebraska. In the Gulf States from Florida to Louisiana, in the autumn of 1913, buyers from Texas and parts of the region to the north bought all of the cows that they could obtain, even scrubs, for stocking and restocking pastures on farms and ranges, for breeding purposes. In a part of Mississippi the poor cotton crop compelled farmers to sell cows to pay debts.

For several years the number of cattle other than milch cows had decreased in Texas, until the droughts of recent years stopped the sale of cattle ranges in the western portion of the State for use as farms, which had been the main cause of the former reduction in number of cattle. The increase of cattle in 1914 was caused by importations from Mexico since the new tariff act went into effect October 4, 1913, permitting the entry of cattle duty free. While it is true that a large fraction of the cattle imported from Mexico goes directly to the slaughterhouses, it is also true that considerable numbers of them have been sent to pastures in the western portion of Texas, where the grazing, because of abundant rains, has for several months been as fine as was ever known. In other parts of the State some of these cattle are pastured on winter wheat and oats.

In California the day of stock cattle is rapidly passing. The ranges are becoming smaller, and the number of range cattle becomes less every year.

The cattle on farms, other than milch cows, are now about three times their number in 1850. The census of that year reported 11,394,000. The number increased to 17,034,000 in 1860, but the losses of the Civil War had not been replaced by 1870, in which year the census disclosed a decline to 14,885,000. Then followed the great extension of settlement on new public and railroad lands west of the Mississippi River, north and south, and this caused an enormous expansion of the raising of cattle for beef. By 1890 the number of these cattle had increased to 34,852,000, and the culmination of the increase was reached at about the time when the census of 1900 was taken, when the number of these cattle was 50,584,000.

Then followed the exhaustion of the supply of public and railroad lands for grazing purposes, the encroachment of settlers upon the ranges, the "no-fence law," the practice of dry farming, and the upward movement of the general price level in which farm animals, products, and land moved upward in price in greater degree than most other products and property did. The upward movement of prices, especially of corn and land, greatly increased the cost of making beef; and, although farmers received high prices for beef cattle, these prices often brought little or no profit.

Farmers have never regarded themselves as having a mission to supply the public with beef at a low price. They have naturally treated this industry purely from an economic viewpoint and whenever they have found that they could make more profit or prevent loss by premature selling of cattle, or by selling some of their production stock, or by selling calves, they have done so. The raising of beef cattle on old-time ranges, on cheap pastures, and on low-priced corn has ceased, and well-informed men perceive that the raising of beef cattle must be established largely on new foundations.

From the highest point reached in number of cattle on farms other than milch cows about 1900, when the number was over 50,000,000, the number declined to 41,178,000 in 1910, and to 35,855,000 in 1914.

COMPARISON WITH POPULATION.

It will help to understand the import of these numbers if they are compared with the population of the years mentioned. The animals under consideration are cattle on farms other than milch cows. There was 0.49 of 1 animal per capita of the population in 1850, and 0.54 of 1 animal in 1860. This average was not surpassed until 1890, when the per capita ratio was 0.55 of 1 animal. The highest point reached, as far as is known, is 0.67 of 1 animal per capita of the population in 1900, from which time the ratio declined rapidly and strikingly to 0.45 of 1 animal per capita in 1910, and 0.36 of 1 animal in 1914, or but little more than half as much as the ratio of 1900. The figures may be found in Table 1.

TABLE 1.—*Number and per capita number of horses, mules, cattle, sheep, and swine on farms, according to the census June 1, 1840 to 1900, and April 15, 1910, and Department of Agriculture estimates, January 1, 1914.*

NUMBER OF ANIMALS.

Year.	Horses.	Mules.	Cattle.			Sheep (not including spring lambs 1840 to 1890).	Swine.
			Total cattle.	Milch (dairy) cows.	Other cattle.		
1840	[1] 4,335,669	(2)	14,971,586	(3)	(3)	19,311,374	26,301,293
1850	4,336,719	559,331	17,778,907	6,385,094	11,393,813	21,723,220	30,354,213
1860	6,249,174	1,151,148	25,620,019	8,585,735	17,034,284	22,471,275	33,512,867
1870	7,145,370	1,125,415	23,820,608	8,935,332	14,885,276	28,477,951	25,134,569
1880	10,357,488	1,812,808	35,925,511	12,443,120	23,482,391	35,192,074	47,681,700
1890	14,969,467	2,295,532	51,363,572	16,511,950	34,851,622	35,935,364	57,409,583
1900	18,267,020	3,264,615	67,719,410	17,135,633	50,583,777	61,503,713	62,868,041
1910	19,833,113	4,209,769	61,803,866	20,625,432	41,178,434	52,447,861	58,185,676
1914	20,962,000	4,449,000	56,592,000	20,737,000	35,855,000	49,719,000	58,933,000

PER CAPITA NUMBER OF ANIMALS.

Year.	Horses.	Mules.	Total cattle.	Milch (dairy) cows.	Other cattle.	Sheep (not including spring lambs 1840 to 1890).	Swine.
1840	[1] 0.25	(2)	0.88	(3)	(3)	1.13	1.54
1850	.19	0.02	.77	0.28	0.49	.94	1.31
1860	.20	.04	.81	.27	.54	.71	1.07
1870	.19	.03	.62	.23	.39	.74	.65
1880	.21	.04	.72	.25	.47	.70	.95
1890	.24	.04	.82	.26	.55	.57	.91
1900	.24	.04	.89	.23	.67	.81	.83
1910	.22	.05	.67	.22	.45	.57	.63
1914	.21	.05	.57	.21	.36	.50	.60

[1] Including mules. [2] Included with "Horses." [3] Not given separately.

GEOGRAPHIC REDISTRIBUTION.

The westward movement of the industry of raising beef cattle gave predominance to the South Central States west of the Mississippi River as the leading geographic division in this industry as early as 1860, and this relative position was not lost until 1880, when it passed to the North Central States west of the Mississippi River, which, as a group, still hold the leading place in this industry among the nine geographic divisions into which the United States is now commonly divided by the Bureau of the Census and by the Department of Agriculture.

From 1850 to 1910 the fraction of the Nation's cattle on farms other than milch cows possessed by New England continuously declined from 7.6 to 1.2 per cent, but slight evidence of recovery appears in 1914, when New England's fraction appears to be 1.4 per cent.

In the Middle Atlantic States the relative position of cattle on farms other than milch cows, in comparison with other geographic divisions, is nearly the same as in New England, except that the Middle Atlantic States have always had a larger number of animals than New England. In 1850 the Middle Atlantic States had 14.6 per cent of the Nation's cattle on farms other than milch cows, and the fraction declined to 4.0 per cent in 1910, followed by a perceptible increase to 4.4 per cent in 1914.

The fractions are of similar import for the South Atlantic States, which had 25.7 per cent of these cattle in 1850, followed by a decline to 6.0 per cent in 1900, after which there was a gain to 8.1 per cent in 1914. This group of States had more of these cattle than any other in 1850.

In the North Central States east of the Mississippi River these cattle were 18.9 per cent of the national total in 1850, and the fraction increased to 21.3 per cent in 1870, after which the decline was steady to 12.1 per cent in 1910. A perceptible tendency toward recovery is indicated for 1914, for which year the percentage is 12.8.

The South Central States east of the Mississippi River had a larger percentage of the Nation's total cattle on farms and ranges other than milch cows in 1850 than they have since possessed. Their percentage for 1850 was 17.8, from which there was a steady decline to 4.8 per cent in 1900, followed by a rise to 5.6 per cent for both 1910 and 1914.

The year 1850 practically antedated the settlement of the Mountain States by white people, and at that time the farm and range cattle other than milch cows were only 0.3 of 1 per cent of the national total. After 1870 the fraction increased rapidly to 11.0 per cent in 1900 and continued to increase in 1910 and 1914, being for the latter year 14.1 per cent.

The Pacific States have remained in nearly a stationary position relatively during the last 50 years. Their fraction of the national total of these cattle in 1850 was 2.5 per cent. It rose quickly to 6.4 per cent in 1860, from which figure it fell to 3.8 per cent in 1870. Subsequently the increase has been slow and has reached the fraction of 5.8 per cent in 1914, somewhat less than that of 1860.

At the present time the North Central States west of the Mississippi River possess 27.7 per cent of the farm and range cattle other than milch cows and the South Central States west of the Mississippi River 20.1 per cent. The States next in order are the Mountain States with 14.1 per cent, slightly below which is the fraction of 12.8 per cent for the North Central States east of the Mississippi River, 8.1 per cent for the South Atlantic States, 5.8 per cent for the Pacific

States, 5.6 per cent for the South Central States east of the Mississippi River, 4.4 per cent for the Middle Atlantic States, and 1.4 per cent for New England.

The Atlantic States, altogether, possess 13.9 per cent of the national total; the Central States east of the Mississippi River possess 18.4 per cent, the Mountain and Pacific States possess 19.9 per cent, and the Central States west of the Mississippi River possess 47.8 per cent, or nearly half of the entire number.

The estimates of the number of these animals in the nine geographic divisions for 1914 indicate that a redistribution of relative numbers has begun geographically. All geographic divisions east of the Mississippi River have begun to increase their fraction of the national total except the South Central States east of the Mississippi River, where the fraction appears to be stationary since 1910. The Mountain States are increasing their fraction, and the Pacific States are apparently holding a stationary position relatively. The prominent beef-cattle producing region for many years, between the Mississippi River and the Rocky Mountains, has begun to lose its relative standing in favor of less prominent geographic groups of States. These changes in relative standing, however, are due to beef-cattle reductions in the great cattle region above mentioned more than to gains in beef cattle elsewhere.

An analysis of the relative distribution of the farm and range cattle, not including milch cows, throughout the geographic divisions of the country may be found in Table 2.

TABLE 2.—*Percentage of live stock in each geographic division of the United States.*

MILCH COWS.

Year.	New England.	Middle Atlantic.	South Atlantic.	East North Central.	West North Central.	East South Central.	West South Central.	Mountain.	Pacific.
1840[1]	....	....	....	....	....	....	....	....	....
1850	9.5	24.8	19.5	20.2	4.3	14.7	6.5	0.3	0.2
1860	7.9	22.6	14.4	22.7	7.1	11.1	10.5	.6	3.1
1870	7.2	24.5	11.2	25.2	11.7	9.3	7.4	.9	2.6
1880	6.0	19.6	10.3	24.0	19.4	9.2	8.1	1.0	2.4
1890	5.0	15.3	8.3	22.7	27.2	8.0	9.2	1.3	3.0
1900	5.2	15.2	8.1	23.1	26.4	7.4	9.6	1.9	3.1
1910	4.1	12.6	8.8	23.4	25.8	7.9	10.9	2.5	4.0
1914	4.0	12.3	8.7	23.6	25.7	7.4	10.6	3.1	4.6

OTHER CATTLE.

Year.	New England.	Middle Atlantic.	South Atlantic.	East North Central.	West North Central.	East South Central.	West South Central.	Mountain.	Pacific.
1840[2]	10.3	22.1	23.4	17.9	3.1	19.4	3.8	....	....
1850	7.6	14.6	25.7	18.9	5.7	17.8	6.9	0.3	2.5
1860	5.3	10.0	15.9	19.6	7.9	12.6	21.8	.5	6.4
1870	4.8	9.4	13.0	21.3	12.7	10.1	23.7	1.2	3.8
1880	3.2	7.9	11.0	19.8	22.5	8.3	18.1	5.3	3.9
1890	1.7	4.4	7.2	15.2	31.7	7.2	18.3	9.6	4.7
1900	1.4	4.2	6.0	13.0	30.8	4.8	24.8	11.0	4.0
1910	1.2	4.0	7.3	12.1	29.9	5.6	20.6	13.5	5.8
1914	1.4	4.4	8.1	12.8	27.7	5.6	20.1	14.1	5.8

[1] Not separately stated.

[2] Total cattle.

TABLE 2.—*Percentage of live stock in each geographic division of the United States*—Continued.

SWINE.

Year.	New England.	Middle Atlantic.	South Atlantic.	East North Central.	West North Central.	East South Central.	West South Central.	Mountain.	Pacific.
1840	2.9	13.9	25.0	21.2	5.2	29.1	2.7	....	....
1850	1.2	7.6	24.7	21.5	6.7	31.2	7.0	0.0	0.1
1860	1.0	6.5	21.5	25.5	10.6	23.7	9.5	0.1	1.6
1870	1.0	6.1	15.3	28.8	16.2	20.7	9.5	0.1	2.3
1880	0.8	4.5	11.9	28.5	29.5	14.2	8.7	0.2	1.7
1890	0.7	4.1	8.9	26.1	39.4	11.4	7.6	0.3	1.5
1900	0.6	3.1	8.8	25.5	38.9	10.6	10.2	0.6	1.7
1910	0.7	3.1	10.2	24.9	36.6	9.3	12.1	1.1	2.0
1914	0.7	3.5	11.2	25.7	33.4	9.9	11.7	1.5	2.4

SHEEP.

Year.	New England.	Middle Atlantic.	South Atlantic.	East North Central.	West North Central.	East South Central.	West South Central.	Mountain.	Pacific.
1840	19.8	36.8	13.6	16.6	1.9	10.6	0.7	....	....
1850	10.4	25.0	13.7	31.4	4.2	11.9	1.4	1.8	0.2
1860	7.9	19.5	11.3	30.7	5.5	10.8	5.1	3.9	5.3
1870	5.1	14.4	7.4	39.2	8.7	7.8	3.5	2.9	11.0
1880	3.9	10.3	7.2	30.0	8.1	6.6	7.9	10.3	15.7
1890	2.6	8.9	6.8	26.3	8.0	6.4	10.9	17.5	12.6
1900	1.4	5.0	4.3	17.3	7.9	3.7	4.6	45.1	10.7
1910	0.8	3.2	3.9	16.5	8.9	3.8	4.2	49.2	9.5
1914	0.8	3.5	4.5	16.9	10.0	4.6	4.9	43.3	11.5

COMMERCIAL MARKETINGS.

The commercial marketings of cattle remain to be considered. The receipts of cattle, including dairy cows but not including calves, have been aggregated for Chicago, Kansas City, Omaha, St. Louis, Sioux City, St. Joseph, and St. Paul, for each year from 1900 to 1913. The cattle received in these seven great markets in the calendar year 1900 numberd 7,179,000, and the number steadily increased to its highest point, 9,591,000, in 1907. In the three years following 1907 the marketings of cattle averaged more than 9,000,000, but in 1911 the decline became sharp, and in 1913 the marketings had the total of only 7,905,000 cattle.

If the high average marketings of the 10 years 1901–1910 are regarded as 100, the marketings for 1907 reached the high point of 107.6, from which, with fluctuations, the relative number declined to 88.7. The marketings for 1900 and 1901 were lower than this.

The marketings of beef cattle, as above mentioned, are to be understood in the light of the attendant circumstances. From 1900 to the present time there has been, more or less, a marketing of breeding stock of beef cattle as well as of steers, calves, and aged cows. For the marketing of calves a separate statement can be made for five of the great markets above mentioned. In 1902, 518,000 calves were received at these markets, and the number increased to 981,000, or nearly double, in 1910, and subsequently sharply declined to 741,000 in 1913. From 1905 to the last year the marketing of calves has largely represented the sale of production stock.

For the results of the compilations of the marketings of cattle and calves, see Table 3.

TABLE 3.—*Yearly marketings of live stock.*

[Combined receipts at Chicago, Kansas City, Omaha, St. Louis, Sioux City, St. Joseph, and St. Paul.]

Year.	Number.				Index (100=yearly average, 1901-1910).			
	Cattle.	Calves.[1]	Hogs.	Sheep.	Cattle.	Calves.[1]	Hogs.	Sheep.
1900	7,179,344	[2] 304,310	18,573,177	7,061,466	80.6	[2] 43.4	100.4	70.6
1901	7,708,839	[2] 356,952	20,339,864	7,798,359	86.5	[2] 51.0	110.0	77.9
1902	8,375,408	517,702	17,289,427	9,177,050	94.0	73.9	93.5	91.7
1903	8,878,789	550,559	16,780,250	9,680,692	99.6	78.6	90.7	96.7
1904	8,690,699	513,034	17,778,827	9,604,812	97.5	73.2	96.1	96.0
1905	9,202,083	730,639	18,988,933	10,572,259	103.3	104.3	102.6	105.6
1906	9,373,825	796,793	18,682,370	10,864,327	105.2	113.7	101.0	108.6
1907	9,590,710	834,781	19,029,775	9,857,877	107.6	119.2	102.9	98.5
1908	8,827,360	854,687	22,334,445	9,833,640	99.1	122.0	120.7	98.3
1909	9,189,312	868,564	18,420,012	10,284,858	103.1	124.0	99.6	102.8
1910	9,265,408	981,309	15,347,791	12,407,418	104.0	140.1	83.0	124.0
1911	8,768,456	975,176	20,453,530	13,556,107	98.4	139.2	110.6	135.5
1912	8,159,888	909,526	20,265,667	13,755,579	91.6	129.8	109.5	137.4
1913	7,904,552	740,662	19,924,331	14,037,830	88.7	105.7	107.7	140.3

[1] Receipts at Chicago, Kansas City, St. Joseph, St. Paul, and Sioux City. No returns for Omaha and St. Louis.

[2] No data for Sioux City.

MILCH (DAIRY) COWS.

NUMBER.

According to the estimate of this bureau, the number of milch cows on farms January 1, 1914, was 20,737,000. This is a slight increase, 0.5 of 1 per cent, over the number as enumerated in the census of 1910, and is 1.2 per cent above the estimate of this bureau for 1913.

Various causes contributed during 1913 to prevent a larger increase in the number of milch cows on farms than is indicated. In New England and westward across the principal dairying States, the work of cow-testing associations has resulted in eliminating many cows that were kept at a loss and these cows were slaughtered. Along the Gulf States from Florida to Louisiana many cows were bought for transportation to pastures in Texas and States to the north to take the place to some extent of cows sold during the severe drought of the summer, because of shortage of pasture and forage. The high prices paid by slaughterers for beef animals of any description, bad as well as good, induced the sale of many dairy cows, for the reason that the prices offered were often much beyond the values of these cows for dairy purposes. The more exacting requirements of city health officers, which have the effect of increasing the cost of producing milk, have also operated to reduce the number of cows on farms. The short supply of feeding stuffs in some sections on account of the prolonged drought, the low production of corn and its high price, and the high prices of feeding stuffs counted against the profitableness of dairying and consequently the milch cows were sold.

On the other hand, causes were in operation to increase the number of dairy cows. Farmers are more inclined to improve their systems of farming than before, and the dependence of the fertility of the soil upon a system of which dairying is a part has caused many farmers to begin or to resume dairying or to enlarge their herds.

The most marked increase in dairying is found in Wisconsin, Minnesota, North Dakota, and South Dakota, where dairying has been extended into new areas.

VALUE.

A most remarkable increase in the value of milch cows per head has occurred since 1910. The average of that year, as ascertained by this bureau, was $35.29; for 1913 it was $45.02; and for 1914, $53.94, an increase of 19.8 per cent over 1913 and of 52.8 per cent over 1910.

The present price is partly the result of a demand that has increased faster than the supply. It is also largely due to the fact that the quality of dairy cows has improved through the weeding out of the unprofitable ones and it is very considerably the result of the greater prevalence of improved breeds.

As the preceding figures indicate, the total value of the milch cows of the United States has increased enormously since the census year 1910. Their total value in that year, as computed by multiplying the census number of animals by the average value per head as determined by this bureau, was $727,802,000. The total value, as determined by this bureau for 1913, was $922,783,000, and the amount for 1914 is $1,118,487,000.

The details concerning the number of dairy cows in 1914, 1913, and 1910 and average value per head and total values for the same years may be found for the various States in Table 13.

PER CAPITA RATIOS.

Dairy cows relative to population were more common than they are now as far back as the first census for them in 1850. At the present time there is 0.21 of 1 dairy cow per capita of the population. In 1910 the ratio was 0.22 of 1 cow and the percentage increased backwards to 1890, when the ratio was 0.26 of 1 dairy cow. Back of that year there was a decline to 0.23 of 1 dairy cow in 1870, preceding which there was an increase to 0.28 of 1 dairy cow per capita of the population in 1850.

It may not be inferred from the trend of the foregoing averages that the quantity of butter fat produced by dairy cows per capita of the population has decreased in the same degrees indicated by the averages for the census years, nor indeed that it has decreased at all. The improvement in both the average quantity and the quality of the milk since 1850 has very likely been sufficient to counteract the diminishing per capita ratios of dairy cows to population.

Details concerning the per capita number of milch cows may be found in Table 1.

GEOGRAPHIC REDISTRIBUTION.

The geographic redistribution of the nation's milch cows as time has advanced is of much interest. At the present time the North Central States west of the Mississippi River contain 25.7 per cent of the entire number of milch cows on the farms of this country and no other division of States has as large a fraction. Next below is the North Central States east of the Mississippi River with 23.6 per cent. Following this is the percentage for the Middle Atlantic States, 12.3, after which follow in order 10.6 per cent for the South Central States west of the Mississippi River, 8.7 per cent for the South Atlantic States, 7.4 per cent for the South Central States east of the Mississippi River, 4.6 per cent for the Pacific States, 4 per cent for New England, and 3.1 per cent for the Mountain States.

New England has steadily lost in the fraction of the nation's milch cows possessed in that region since 1850 and so have the Middle Atlantic and East South Central States; but the South Atlantic States had a diminishing percentage until 1900, after which there was an increase to 8.8 per cent in 1910, followed by the trace of a decline in 1914.

The East North Central States in 1850 had about one-fifth of the milch cows of the United States and the Middle Atlantic States more than one-fourth, but the East North Central States took the lead in 1860 and kept it until 1880, when the leading place was taken by the West North Central States. From 1850 to the present time the East North Central States have held either first or second place in the possession of number of milch cows, in comparison with other geographic divisions.

The West North Central States had but 4.3 per cent of the milch cows on farms in 1850 and the percentage rapidly increased to 27.2 in 1890, from which it declined to 25.7 per cent in 1914.

The West South Central States now have about the same fraction of the nation's dairy cows on farms that they had in 1860, which was slightly more than 10 per cent. The lowest fraction for an intermediate census year was 7.4 per cent in 1870. The Mountain States have slightly increased their fraction of the nation's dairy cows on farms from 1850 to the present time; but the Pacific States had the same fraction in 1900 that they had in 1860, 3.1 per cent; but since 1900 the fraction has increased to 4.6 per cent at the present time.

BUTTER.

Under the new tariff of October 4, 1913, all cattle may be imported free of duty. Previous to that time dairy cows were subject to a duty of 27.5 per cent ad valorem. The new tariff reduces the duty on butter from 6 to 2 cents per pound. Substantially no dairy cows are imported into the United States, except so far as pure-bred cows imported for breeding purposes may be regarded as dairy cows.

The high price of butter during the autumn of 1913 and the present winter and the reduction of the duty have made an opening for the increased importation of butter. These importations have come from New Zealand, Australia, Siberia, and Canada. In the fiscal year ending June 30, 1912, 1,025,668 pounds of butter were imported; in the fiscal year 1913, 1,162,253 pounds of butter; and during the five months, July to November, 1913, 1,984,891 pounds were imported. This looks like a small quantity compared with the production of 1,700,000,000 pounds of butter in this country in 1909 as ascertained by the census.

Much of the butter imported last autumn was of low grade, and more or less of this was reworked, or at any rate repacked, and sold as domestic butter, according to commercial reports.

SHEEP.

NUMBER.

A very considerable decline in the number of sheep has taken place since 1910. In that year the number on farms as ascertained by the census was 52,448,000; the estimate for January 1, 1914, is 49,719,000, a decline of 3.4 per cent from 1913 and of 5.2 per cent from 1910.

Among the causes that have contributed to the diminution of number of sheep is the scarcity of labor required for their care, the high prices of sheep and lambs for slaughter, the displacement of sheep by expanding dairying, deficient pasturage and forage on account of drought, destruction by dogs, the settlement of range land previously occupied by sheep, and the low price of wool; also the increasing value of land.

According to the reports of correspondents the low price of wool is the most prominent cause. In view of the general agreement of correspondents with regard to this, the accompanying Table 4 has been prepared to show the range of wholesale prices of wool per pound in the Boston market from 1899 to December, 1913. The highest prices for Ohio fine unwashed wool since 1899 ranged from 23 to 30 cents from 1905 to 1909; for 1913 the range was 20 to 24 cents. Similar declines are observable in the cases of the other wools included in the table.

During 1913 the price of Ohio fine unwashed wool declined from 24 cents in January to 20–21 cents in December; of Ohio XX washed from 32 cents in January to 25½–26 cents in December; for Ohio Delaine washed from 34 cents in January to 26–27 cents in December; for selected Territory staple scoured, from 66–67 cents in January to 51–53 cents in December; for fine medium Territory clothing scoured, from 57–59 cents in January to 46–48 cents in December; and for fine free fall Texas scoured, from 47–50 cents in January to 41–43 cents in December.

TABLE 4.—*Range of wholesale prices of wool per pound in Boston, 1899–1913.*

Date.	Ohio fine, unwashed.		Ohio XX, washed.		Ohio Delaine, washed.		Fine selected Territory, staple scoured.		Fine medium Territory, clothing scoured.		Fine free fall. Texas scoured.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
1899	16	26	25½	38	27	40	42	75	38	62	30	52
1900	18	26	27	38	27½	40	49	74	45	62	40	55
1901	16½	19½	26	28	27½	30	43	50	35	44	36	42
1902	19	23	27	32	28	35	48	59	42	50	38	48
1903	20	25	30	35	33½	37	52	60	50	58	44	48
1904	21	25	32	36	34	38	50	70	50	68	44	56
1905	23	30	34	37	36	40	65	78	60	72	54	63
1906	24	28	33½	36	35½	37½	70	78	65	70	58	63
1907	25	28	33	35	36	39	70	75	66	73	50	62
1908	19	27	30	35	31	39	53	72	43	62	42	53
1909	23	28	34	38	37	42	62	80	60	72	45	62
1910	20	28	30	38	34	40	60	80	54	68	48	62
1911	18	22	27	32	29	34	53	62	51	60	41	50
1912	21	25	28	33	30	35	60	67	48	59	42	48
1913.												
January	24	24	32	32	34	34	66	67	57	59	47	50
February	24	24	32	32	33	34	63	65	57	58	49	50
March	23	24	29	32	30	34	57	65	54	58	47	50
April	21	23½	27	29	29	31	55	60	51	55	45	48
May	20	21	27	28	27	30	55	56	49	53	45	46
June	20	21	27	27	27	28	55	56	49	50	45	46
July	20	21	27	30	27	28	55	56	49	50	45	46
August	20	21	26	30	27	28	54	55	49	50	45	46
September	20	21	25	26	27	28	53	55	48	50	45	46
October	20	21	25½	26	27	28	53	54	46	50	43	46
November	20	21	25½	26	26½	28	53	54	46	48	41	45
December	20	21	25½	26	26	27	51	53	46	48	41	43
The year.	20	24	25	32	26	34	51	67	46	59	41	50

VALUE.

In spite of the decline in the number of sheep, their value per head has increased 10 cents within a year and was $4.04 January 1, 1914. This, however, is a decline of 1.9 per cent from the price of January 1, 1910.

The total value of all sheep on farms January 1, 1914, was $200,803,000, a decline of 1 per cent from 1913 because of the decline in the number of sheep, and a decline of 7 per cent from the total for 1910 because of a decline in both number of sheep and value per head.

Details for number and value of sheep in the various States may be found in Table 14.

Since 1900 sheep keeping has been declining in this country to a very marked degree. The number of sheep in that year was 61,500,000, while the present number is 19.2 per cent less, with a prospect of further diminution unless sheep are to be raised primarily for meat with wool as a by-product.

PER CAPITA OF THE POPULATION.

The number of sheep in this country per capita of the population was 1.13 according to the census of 1840. The number diminished to 0.57 of 1 sheep in 1890. During this period the census excluded spring lambs from enumeration. These were included in 1900 and subsequently. In 1900 the ratio per capita of population was 0.81 of 1 sheep and the ratio declined to 0.50 of 1 sheep in 1914. Details of figures may be found in Table 1.

GEOGRAPHIC CHANGES.

The most striking geographic redistribution of a class of farm animals from the earliest census to the present time is perhaps afforded by sheep. In 1840 the Middle Atlantic States had 36.8 per cent of all sheep on farms and New England was second with 19.8 per cent. The third place was held by the east North Central States with 16.6 per cent, while next in order were the South Atlantic States with 13.6 per cent, the east South Central States with 10.6 per cent; the west North Central States with 1.9 per cent, the west South Central States with 0.7 of 1 per cent, and no sheep at all, as far as the census ascertained, in the Mountain and Pacific States.

Now New England and New York occupy the lowest and next to the lowest place, respectively, in the possession of sheep on farms, and a little less than 5 per cent of the national total is possessed by each of the South Atlantic, east South Central, and west South Central States. The west North Central States have 10 per cent of the total, the Pacific States 11.5 per cent, while nearly one-half of the sheep of the Nation, or 43.3 per cent, are in the Mountain States, where sheep raising is a range industry. Particulars with regard to the geographic distribution of sheep may be found in Table 2.

SHEEP MARKETING.

The receipts of sheep at seven principal marketing centers have been compiled for 1900 to 1913, with results that may be found in Table 3. The record shows a marked increase in the number of sheep received for slaughter at these places after 1909, leading up to the highest number ever received, 14,000,000, in 1913. Here is clearly a case of the slaughtering of production stock kept for wool production.

HAVE SHEEP A PLACE ON AMERICAN FARMS?

The following paragraphs by George M. Rommel, Chief of the Division of Animal Husbandry, Bureau of Animal Industry, are included here as of interest in the discussion of sheep:

The estimates of the department for the number of sheep on farms in the United States on January 1, 1914, show a decided decrease as compared with 1913. The apparent tendency toward a decline in the number of sheep on farms has been noted for some time and has caused sheep raising on farms to be referred to as a waning industry. A word here concerning the economy of sheep and their place in agricultural practice may not be out of place.

As a farm animal per se, the sheep has many distinct advantages.

(1) The sheep is a much more economical animal to feed than the steer, returning a larger amount of gain per 100 pounds of feed eaten. When his capacity to consume roughage is considered, he is more economical than the hog.

(2) The sheep yields a double return—meat at an economical cost, and wool as a by-product—which will go far toward defraying the cost of keep.

(3) Sheep are prolific. A farm flock which does not yield at least 100 per cent increase is very poor indeed.

(4) A flock of sheep on a farm will, in time, clear it of weeds, without expense to the owner, if allowed to range the lanes, the stubble fields after grain is cut, and the cornfields after the corn is full grown. As a scavenger, even a goat is not more useful than a sheep.

As meat-food animals sheep have never been sufficiently appreciated in the United States. They are, however, of very great value. They must be classed with hogs and poultry as the most available animals to supply meat for home use on the average farm. They are readily slaughtered, the meat can be kept without difficulty; it cuts up without waste in sizes which are convenient for the average family, and the meat is nutritious, wholesome, and palatable when properly cooked. The healthfulness of the sheep alone gives it front rank as a meat-food animal. Sheep rarely have tuberculosis or other diseases communicable to man.

The foregoing statements are axiomatic. If the sheep industry is so inviting, why do our farmers seem to be showing a tendency to curtail sheep raising? In my opinion there are three principal causes.

First. Intestinal parasites, principally stomach worms, cause serious losses in farm flocks over the whole country, and almost entire lamb crops are sometimes exterminated. In no farming sections are sheep free from this danger, and no breed of sheep is immune, although some breeds—the Merinos, for example—are less susceptible than others. No infallible cure for stomach worms is known, but it is possible to control them economically by keeping the lambs away from the ewes except when nursing, and by a system of pasture rotation. Unless a farmer is willing to take precautions in the management of the flock he should not raise sheep.

Second. Cur dogs are almost as great a hindrance to the sheep industry as parasites. The only protection against them is to keep the flock during the day where it can be watched and to put it into a dog-proof inclosure at night. An authentic case has recently been reported from Michigan where a flock of more than 200 head were all run to death in one night by two cur dogs. Dog-tight night folds can be built of woven wire at small expense.[1]

Third. Farmers have not generally recognized the proper place of the sheep in agriculture in the settled regions. Too much importance is placed on wool. Except on the range, where land is cheap, the wool should be regarded as an incidental—a side line to help defray the cost of handling. Raising sheep for wool alone does not pay on farms, and the attempts of farmers to make it pay is undoubtedly largely responsible for the prevailing opinion that sheep are not profitable on expensive land. Sheep are raised in England on some of the most expensive land in the Kingdom, but they are raised as meat animals and not as wool producers; the wool is a by-product, as it should be in farm flocks.

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[1] See Bull. 20, U. S. Dept. Agr., for details of sheep management.

If only 25 per cent of the farms on which there are now no sheep should have a flock of not over 25 or 30 ewes, managed with reasonable care and protected against dogs, not only would farm revenues be materially increased but a decided step in advance would be taken toward the solution of our meat-supply problem.

SWINE.

NUMBER.

Although the estimated number of swine on farms January 1, 1914, 58,933,000, was 1.3 per cent more than the census number for 1910, the decline from 1913 was 3.7 per cent. This decline is partly accounted for by the extensive prevalence of hog cholera, by high-priced corn, by the deficient production of 1913 because of a severe long-continued and extensive drought and because of the high prices of swine for slaughter. Notwithstanding the high price of hogs for slaughter, farmers found that they could not profitably feed the high-priced corn. At the same time, the price of hogs per hundred pounds was high relatively, although not as high as corn. In this situation hogs were often sent to market undersized.

AVERAGE WEIGHT OF HOGS ON THE FARM.

The average size of hogs on the farm January 1 has never been directly ascertained, but it may be computed from the average price per head divided by the average price per hundred pounds, as ascertained by this bureau. As a result of this operation, the average weight of a hog on the farm January 1, 1914, was 145 pounds; in 1913 it was 144 pounds; in 1912, 140 pounds; and in 1911, 131 pounds. The marketing of low-weight hogs, which has been frequently commented upon in live-stock and commercial papers during the last three years, is apparent in the foregoing average weights, which are apparently high because the lighter hogs have been sold off.

VALUE.

The average value of swine on farms per head January 1, 1914, was $10.40, or 5.5 per cent above the average value of January 1, 1913, and 13.4 per cent above that of 1910. In consequence of the increased value of swine per head, the total value of all swine on farms is estimated at $612,951,000, or a gain of 1.6 per cent over 1913 and 14.9 per cent over 1910. The diminution of swine January 1, 1914, was more than counterbalanced by the increased price per head of those that were on hand.

Particulars for the number and value of swine are presented in Table 15 for the various States.

RELATION TO POPULATION.

Swine are quite as conspicuous as sheep in exhibiting a declining per capita ratio. At the time of the census of 1840, the number of swine per capita of population was 1.54. Steadily the ratio declined to 0.65 of 1 animal in 1870, but from that low average there was recovery to 0.95 of 1 animal in 1880. After that year the decline was steady to 0.60 to 1 animal per capita of population in 1914. These figures may be found in Table 1.

CHANGES IN GEOGRAPHIC IMPORTANCE.

Great changes have taken place in the geographic redistribution of swine since 1840, when the East South Central States led the geographic divisions of the country in the possession of number of swine. The fraction of the national total in that division was then 29.1 per cent. Next in order at that time was the South Atlantic group with 25.0 per cent; so that the South, east of the Mississippi River, possessed 54.1 per cent of the swine of the country at that date.

In 1914 the leading division is the West North Central States, while the division second in importance is the East North Central States. Altogether, these divisions have 59.1 per cent of the Nation's swine, or a little more than the South east of the Mississippi River possessed in 1840 as a fraction of the Nation's total. In 1914 the division that is third in importance in the possession of swine is the West South Central, with the fraction of 11.7 per cent of the Nation's swine. After this follow in order the South Atlantic States with 11.2 per cent, the East South Central States with 9.9 per cent, the Middle Atlantic States with 3.5 per cent, the Pacific States with 2.4 per cent, the Mountain States with 1.5 per cent, and New England with 0.7 of 1 per cent. Details of the geographic distribution may be found in Table 2.

COMMERCIAL MOVEMENT.

Hogs are more prolific than any other farm animal and consequently contribute a larger number to slaughter than any other class. In seven markets the receipts of hogs from 1900 to 1913 may be found expressed in Table 3. Swine have the ability to recuperate in numbers after extraordinary losses more quickly than any other class of animals. For illustration, it may be observed that in 1908 an extremely large number of hogs were received at these seven principal markets, and that was the year when there was a large slaughter of production stock. The marketing of the two following years indicate as much, but in the third year thereafter there had been recuperation. In 1913 the hogs received at these markets numbered 19,924,331, which was somewhat under the 20,265,667 received in 1912. The receipts in 1913 at these seven markets have been exceeded in 1901, 1908, 1911, and 1912.

HORSES.

NUMBER MAINTAINED AGAINST OBSTACLES.

In the days of the bicycle's rapid increase in popularity, it was supposed that the horse would be considerably displaced by that machine. Then came the use of electric power for urban and suburban street cars, and this was in turn followed by the automobile, which, in popular belief, is pushing the horse toward extinction. A little-noticed competition to the horse is the increasing use of farm tractors, most of which receive their power from gasoline.

In spite of everything that has been threatening, the horses of the census of 1910, which numbered 19,833,000, have increased to 20,962,000 January 1, 1914, or 5.7 per cent. The increase over 1913 is 1.9 per cent.

Although the horses are maintaining their numbers and, indeed, are increasing, the relative importance of breeds is changing. The automobile is having the effect of diminishing the number of light driving horses, and, notwithstanding the increased use of autotrucks, the number of heavy draft horses has much increased in importance. The old-time prairie ponies have been substantially pushed aside by the better-bred horse. In Texas, for instance, these ponies have been mostly eliminated with the disappearance of ranches and the development of agriculture, which demands horses of better blood and higher value.

On the other hand, there is a decline in the number of horses in California, owing to an unusually extensive and general use of autotrucks and traction engines.

VALUE.

The value of horses per head January 1, 1914, is $109.32, a decrease of 1.3 per cent from 1913, but an increase of 1.2 per cent over 1910. As a result of a larger number of horses in 1914 than in 1913, although the value per head is lower, the total value of all horses on farms January 1, 1914, is $2,291,638,000, or an increase of 0.6 per cent over 1913 and of 7 per cent over 1910. The value and number of horses on farms January 1, 1914, was the highest ever reached in this country.

Details for number and value of horses in the separate States may be found in Table 16.

The average value of horses per head is based on horses of all ages and breeds. In connection with this average, in recent years, it may be mentioned that this bureau recently ascertained that the cost of raising a horse until 3 years old, as a general average for the United States, was $104.05, from which should be subtracted the average value of the work done, $7.52, leaving the net cost at $96.53, which, at the time when the cost was determined, was 70.9 per cent of the farm value of a 3-year old. The most important element in the cost of raising a horse was the cost of feed, which amounted to 54.1 per cent of the total cost.

PER CAPITA OF POPULATION.

The number of horses on farms can be better understood if they are compared with population. In 1850 there was 0.19 of 1 horse per capita of population, and the ratio remained about the same until about 1890 and 1900, when the ratio was 0.24 of 1 horse. After 1900 the ratio declined to 0.21 of 1 horse in 1914, or to as high a ratio as existed before 1890 and to a higher one than existed before 1880. For figures relating to the per capita ratios, Table 1 may be examined.

MULES.

NUMBER AND VALUE.

Mules as well as horses have been more than maintained in number. From the census number of mules in 1910, the increase is to 4,449,000, the number for January 1, 1914, or 5.7 per cent, and the increase in 1914 over 1913 is 1.4 per cent.

There has been a slight falling off in the average value of farm mules per head January 1, 1914, as compared with the preceding year, and the latter value, $123.85, is 0.4 of 1 per cent lower than the former, but the increase over 1910 is 3 per cent. In consequence of the increased number, in spite of the diminished value per head the total value of all mules on farms reached the heretofore unequaled total of $551,017,000 January 1, 1914, which was an increase of 11 per cent over 1913 and of 8.9 per cent over 1910.

State details of number and value of mules are given in Table 17.

The mule is the only farm animal covered by this report which has increased per capita of population. The ratio in 1850 was 0.02 of 1 mule per capita of population and the ratio remained substantially at 0.04 of 1 mule from 1860 to 1900, after which it rose to 0.05 of 1 mule per capita of the population. The increased use of mules has followed the expansion of cotton growing and perhaps this fact more than anything else has caused the increase of number and of per capita number of mules.

SUMMARY OF NUMBER AND TOTAL VALUE.

It remains now to aggregate the farm animals for number and total value. The cattle of January 1, 1914, according to the estimates, had a total of 56,592,000 head, and this was an increase of 0.1 per cent from 1913 and a decrease of 8.4 per cent from 1910. The aggregate value, however, on account of the great increase in the average value per head, became $2,234,820,000 for January 1, 1914, for all cattle, or an increase of 19.4 per cent over 1913 and 47.7 per cent over 1910.

Although differing widely in the uses and values per head, the farm animals covered by this report, namely, horses, mules, milch cows, other cattle, sheep, and swine, are aggregated for several years for the purpose of a rough comparison. The total aggregate number of these six classes of animals, as determined by the census of 1910, was 196,480,000 head. In 1913 the number was estimated by this bureau at 194,140,000, and the estimate of January 1, 1914, is 190,655,000 head, a decrease of 1.8 per cent from 1913 and of 3 per cent from 1910. On the other hand increases, are found in aggregate values. For 1910 the value of these six classes of farm animals was $4,910,975,000; for 1913, $5,501,783,000; and for 1914, $5,891,229,000, or an increase of 7.1 per cent over 1913 and of 20 per cent over 1910.

BREEDING FEMALES.

An important change occurred in the relative number of the breeding females in the case of cattle and sheep from 1900 to 1910. In 1900 the cows and heifers were 53 per cent of all cattle, but the percentage increased to 65 in 1910, showing how much more closely the other members of the herds had been sold off. The computation for ewes shows that they were 52 per cent of all sheep in 1900, but had become 60 per cent in 1910. The explanation is doubtless the same as the one for cattle.

MEAT PRODUCTION AND CONSUMPTION.

A NATIONAL PROBLEM.

Four distinctive classes of meat animals supply nearly the entire meat production of this country. These are milch cows, other cattle, sheep, and swine. Milch cows have maintained a substantially uniform number since the census of 1910 and then declined relative to population. There has been a decided absolute decline in the number of other cattle and a considerable decline of sheep, with the prospect of continued decline until the sheep industry can be established primarily on a meat basis with wool as a by-product. Swine have declined during the last three years, but still the number is absolutely larger than in 1910, although the per capita number is diminishing. In view of these circumstances, a statement of what is known with regard to the production and consumption of meat in this country must be of national interest.

AMOUNTS EXPRESSED IN DRESSED WEIGHT.

It has been estimated by this bureau that the production of meat in 1900 amounted to 16,052,000,000 pounds, as customarily expressed in dressed weight, but including lard. This does not include the extra edible parts, such as heart, liver, tongue, etc.

Of this production, 2,433,000,000 pounds were exported, so that the consumption amounted to 13,619,000,000 pounds, dressed weight. The consumption of beef in 1900 disposed of 5,853,000,000 pounds; of veal, 758,000,000 pounds; total beef and veal, 6,611,000,000 pounds; of mutton and lamb, 587,000,000 pounds; of pork excluding lard, 5,405,000,000 pounds; of lard, 1,017,000,000 pounds; total pork, including lard, 6,422,000,000 pounds.

An estimate of the production of meat in 1909, partly resting on the method previously adopted by this bureau, but taking advantage of additional information provided by the census, was made by Mr. John Roberts, of the Bureau of Animal Industry, and published in the annual report of that bureau for 1911. In this estimate the production of meat in 1909, on the basis of dressed weight, including lard, was 16,863,000,000 pounds, or 811,000,000 pounds more than in 1900.

The exports, however, declined to 1,263,000,000 pounds, or almost exactly one-half the exports of 1900, and the meat remaining for consumption, as expressed in dressed weight, was 15,600,000,000 pounds, or 1,981,000,000 pounds more than in 1900.

The consumption of beef increased during the nine years to 7,276,000,000 pounds, or 1,423,000,000 pounds more than in 1900, but the consumption of veal fell to 683,000,000 pounds, or 75,000,000 below the amount of 1900.

The mutton and lamb consumption in 1909 is estimated at 596,000,000 pounds, or an increase of 9,000,000 pounds above the consumption of 1900.

The pork and lard consumption for 1909 presents an increase of 612,000,000 pounds for 1909, as compared with 1900, and amounted to 7,034,000,000 pounds. An estimate of the consumption of goat meat in 1909 results in 11,773,000 pounds.

PER CAPITA RATIOS.

Still bearing in mind that the foregoing figures stand for dressed meat weight and exclude the many extra edible parts that go into consumption, a comparison of 1909 with 1900 may be made with regard to per capita production and consumption of meat that is embraced in the description "dressed weight."

By a rough and very imperfect computation, the production and consumption of meat in 1914 an estimated and these estimates in per capita form of expression are introduced for expanding the comparison.

The per capita production of dressed weight meat declined from 211.2 pounds in 1900 to 186.2 pounds in 1909 and to 160.6 pounds for 1914, and the per capita exports of meat declined from 32 pounds in 1900 to 14 pounds in 1909, and to 8.7 pounds in the fiscal year 1913.

The consumption of meat, dressed weight, per capita, declined from 179.2 pounds in 1900 to 172.3 pounds in 1909, and then to 151.9 pounds for 1914.

Comparison of 1909 with 1900 with regard to different kinds of meat is not extended to 1914. For beef there was an increase of per capita consumption from 77 to 80.3 pounds, but the consumption of veal declined from 10 to 7.6 pounds, so that the per capita consumption of beef and veal increased almost 1 pound, or from 87 to 87.9 pounds.

The per capita consumption of mutton and lamb fell from 7.7 pounds to 6.6 pounds from 1900 to 1909, and the per capita consumption of pork, including lard, declined from 84.5 to 77.7 pounds. Goat meat was consumed to the extent of 0.13 of 1 pound per capita in 1909.

DRESSED WEIGHT AND EXTRA EDIBLE PARTS.

The foregoing numbers refer to meat production and consumption in terms of dressed weight and are fairly comparable with similar numbers for foreign countries. The dressed weight basis is the one commonly adopted. There is a large production of meat, however, which has been termed "extra edible parts." These are not included in dressed weight. This bureau has estimated the production of meat embraced within the description of "extra edible parts" for 1900, and a similar estimate has been made by Mr. Roberts, of the Bureau of Animal Industry, for 1909; a very rough and imperfect calculation of this production has been added for 1914.

The years 1900, 1909, and 1914 may now be compared with one another with regard to the production and consumption of all meat; that is, the dressed-weight meat, plus the extra edible parts. The extra edible parts contributed 2,601,000,000 pounds of meat to the dressed weight in 1900 and 2,366,000,000 pounds in 1909, so that the per capita consumption of meat in dressed weight was increased on this account by 34.2 pounds in 1900 and by 26.1 pounds in 1909. The per capita consumption of meat, including extra edible parts, was 213.4 pounds in 1900, 198.4 pounds in 1909, 160.3 pounds for 1914; and the total consumption was 16,220,000,000 pounds in 1900, 17,966,000,000 pounds in 1909, and, as roughly estimated, of 15,810,000,000 pounds of meat in 1914.

The total production of meat, including extra edible parts, was 18,653,000,000 pounds in 1900, or 245.5 pounds per capita; it was 19,229,000,000 pounds in 1909, or 212.3 pounds per capita; and the estimate for 1914 is 16,675,000,000 pounds, or 169 pounds per capita.

During the nine years from 1900 to 1909 the total meat production, including extra edible parts, increased 576,000,000 pounds, or 3.1 per cent; but from 1900 to 1914 the meat production decreased 1,978,000,000 pounds, or 10.6 per cent. The total meat consumption, including extra edible parts, increased 1,746,000,000 pounds, or 10.8 per cent, from 1900 to 1909; but from 1900 to 1914 the estimate indicates a decrease of 410,000,000 pounds, or 2.5 per cent.

The exports of meat decreased 1,170,000,000 pounds, or 48.1 per cent, from 1900 to 1909, and the decrease from 1900 to the fiscal year 1913 was 1,568,146,000 pounds, or 64.5 per cent.

The population increased 19.2 per cent from 1900 to 1909, and the estimate of increase for 1914 over 1900 is 29.8 per cent.

Finally, it may be stated that the per capita consumption of meat, including the extra edible parts, decreased 7 per cent from 1900 to 1909, and 24.9 per cent from 1900 to 1914. The production and consumption of dressed-weight meat are expressed in tabular form in Table 5.

TABLE 5. –*Estimated total and per capita production and consumption of meat, 1900 and 1909.*

[Bureau of Statistics (Agricultural Forecasts) and Bureau of Animal Industry. Computed on the basis of dressed weights; approximately comparable with estimates for foreign countries]

Kind of meat.	Total pounds.		Per capita pounds.	
	1900	1909	1900	1909
PRODUCTION.				
Production (consumption and exports)	16,052,487,000	16,862,987,000	211.2	186.2
Exports	2,433,035,000	1,263,033,000	32.0	14.0
CONSUMPTION.				
Beef	5,852,815,000	7,275,632,000	77.0	80.3
Veal	758,030,000	682,826,000	10.0	7.6
Total	6,610,845,000	7,958,458,000	87.0	87.9
Mutton and Lamb[1]	586,972,000	595,888,000	7.7	6.6
Pork (excluding lard)	5,404,624,000	6,122,796,000	71.1	67.6
Lard	1,017,011,000	911,039,000	13.4	10.1
Total	6,421,635,000	7,033,835,000	84.5	77.7
Goat meat	....	11,773.000	....	.1
Total meat (including lard.)	13,619,452,000	15,599,954,000	179.2	172.3

[1] A former estimate of mutton and lamb production for 1900 made by the Bureau of Statistics (Agricultural Forecasts) has been reduced to place it on the census basis for 1909 and especially to make it conform to the smaller number of animals on April 15, the date of the census for 1910, instead of to the number on June 1, the date of the census for 1900.

IMPORTS OF MEAT AND MEAT ANIMALS.

A statement of quantities of imports of meat and meat animals for the fiscal years 1912 and 1913, and the first five or six months of the fiscal year 1914 may be found in Table 6. In this table it appears that the total number of cattle, including a few introduced for breeding purposes, imported in 1912 was 318,372; in 1913, 421,649; and in the first five months of 1914, 404,313. The imports of the five months are almost entirely from Mexico and Canada.

The imported sheep of 1912 number 23,588; of 1913, 15,428; and for the first five months of 1914, 75,620, mostly from Canada.

During the first six months of the fiscal year 1914, the imports of beef and veal had a total of 33,645,364 pounds; of mutton and lamb, 439,065 pounds; of pork, 286,871 pounds; of bacon and hams, 116,130 pounds. The imports for previous years were so small that they were not separately designated in the reports of the Department of Commerce.

TABLE 6.—*Imports, 1912, 1913, and total for 5 months, July–November, 1913.*

Commodity.	Quantity.		
	Year ending June 30—		5 months, July–November, 1913.
	1912	1913	
	Number.	*Number.*	*Number.*
Cattle.. Dutiable, July–September			150,016
Cattle.. All, October–November			253,757
Canada	1,350		181,617
Mexico	315,227	391,477	221,818
United Kingdom	1,795	981	878
Total	318,372	421,649	404,313
Sheep.. Dutiable, July–September			1,883
Sheep.. All, October–November			73,030
Canada	17,629		
Mexico	5,152		
United Kingdom	802		
Total	23,588	15,428	75,620
	Pounds.	*Pounds.*	*Pounds.*
Beef and veal (July–December)			[1] 33,645,364
Mutton and lamb (August–December)			[1] 439,065
Pork (August–December)			[1] 286,871
Bacon and hams (October–November)			[1] 116,130
Sausages, bologna:			
Denmark	34,023		
France	11,015		
Germany	619,310		
Italy	6,120		
Netherlands	33,832		
Mexico	263,852		
Total (July–December)	971,775	728,469	[1] 410,563

[1] Total, six months, July to December. July to November, from Department of Commerce; December, rom Bureau of Animal Industry inspected meat report.

INSPECTION OF IMPORTED MEATS.

The new tariff act provides that imported meats and meat products shall be inspected by the Bureau of Animal Industry of this department before being allowed to enter this country for consumption. The quantities of inspected meats and meat products imported from October 4 to December 31, 1913, are expressed in tabular form in Table 7, with specification of the countries from which the imports were consigned. The meats are expressed as fresh and frozen beef and veal, mutton, and pork; canned beef and veal, and other meats; cured beef and pork; sausage; oleo-stearin, and other meat products.

The total number of pounds of meat and meat products imported and not condemned in October, 1913, was 6,000,735; in November, 11,820,889; in December, 16,074,520 pounds; total, three months, 33,896,144 pounds. The condemned meat of the three months weighed 17,493 pounds.

The principal countries contributing to the total were, in order of magnitude of contributions, Argentina, Canada, and Australia. Table 7 may be examined for further details.

TABLE 7.—*Imported meat and principal meat products from principal countries, inspected by the Bureau of Animal Industry, October to December, 1913.*

Month and country from which consigned.	Total not condemned.	Fresh and frozen.			Canned.	
		Beef and veal.	Mutton.	Pork.	Beef and veal.	Other meats.
1913.						
October:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Argentina	2,115,864	2,069,794				
Australia	807,604	653,145	2,179		152,280	
Canada	2,501,108	2,337,272	958	5,942	25,338	
Mexico	15,272	5,357	9,915			
Uruguay	559,843	559,843				
Other countries	1,044				30	
Total	6,000,735	5,625,411	13,052	5,942	177,648	
November:						
Argentina	4,093,836	3,988,898	10,204		31,025	
Australia	1,917,538	1,681,156			230,571	5,811
Canada	5,625,402	4,811,998	5,708	174,019	36,778	2,376
Mexico	40,858	27,073	13,785			
Other countries	143,255	179	1,000		1,499	175
Total	11,820,889	10,509,304	30,697	174,019	299,873	8,362
December:						
Argentina	10,354,674	9,440,488	237,422		130,176	
Australia	1,854,895	1,289,143	80,918		483,894	880
Canada	2,601,273	2,057,481	8,254	132,243	8,366	1,644
France	477,266					
Germany	129,279	293			545	
Mexico	25,417	25,417				
Uruguay	494,454	494,454				
Other countries	137,262		54		13,360	4,673
Total	16,074,520	13,307,276	326,648	132,243	636,341	7,197

Month and country from which consigned.	Cured.		Sausage.	Oleo stearin.	Other meat products.	Condemned.
	Beef.	Pork.				
1913.						
October:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Argentina				46,070		
Australia						795
Canada	8,575	114,214	3		8,806	3,870
Mexico						25
Other countries		250	764			
Total	8,575	114,464	767	46,070	8,806	4,690
November:						
Argentina				63,709		462
Australia						658
Canada	114,130	458,417	908		21,068	13,049
Other countries	170	16,191	13,371	110,670		18
Total	114,300	474,608	14,279	174,379	21,068	14,187
December:						
Argentina				546,588		816
Australia			60			
Canada	149,004	198,164	2,545		43,572	11,723
France	929			476,337		
Germany	70	24,638	103,733			
Mexico						21
Uruguay						4,933
Other countries	7,300	53,163	36,205	22,000	507	
Total	157,303	275,965	142,543	1,044,925	44,079	17,493

OLD AND NEW TARIFF RATES.

For its bearing on the supply of meat and meat products from other countries a concise statement of the old and new tariff rates on meat animals and some of their products and on dairy products has been prepared and may be found in Table 8. It will be observed that the meat animals may be imported free of duty and also all meats, whereas formerly rates of duty were provided.

Table 8.—*Old and new tariff rates on meat animals and on principal meat and meat-animal products.*

Commodity.	Before Oct. 4, 1913.	Oct. 4, 1913, and after.
Animals:		
Asses	Breeding purposes and teams of immigrants, free; all other, 20 per cent ad valorem.	Breeding purposes and teams of immigrants, free; all other, 10 per cent ad valorem.
Cattle	Breeding purposes and teams of immigrants, free; all other: Less than 1 year, $2 per head; all other, worth not over $14, $3.75 per head; worth over $14, 27½ per cent ad valorem.	Free.
Goats	20 per cent ad valorem	Free.
Horses	Breeding purposes and teams of immigrants, free; all other: Worth $150 or less per head, $30; worth over $150, 25 per cent ad valorem.	Breeding purposes and teams of immigrants, free; all other, 10 per cent ad valorem.
Mules	Same as horses	Same as horses.
Sheep	Breeding purposes, free; all other: Less than 1 year old, 75 cents per head; 1 year old and over, $1.50.	Free.
Swine	Breeding purposes, free; all other, $1.50 per head.	Free.
Dairy products:		
Butter	6 cents per pound	2½ cents per pound.
Cheese	do	20 per cent ad valorem.
Cream	5 cents per gallon	Free.
Milk	Fresh, 2 cents per gallon; condensed and evaporated, 2 cents per pound.	Free.
Hides and skins, raw	Free	Free.
Meat:		
Beef and veal	Fresh beef, 1½ cents per pound; other beef, 25 per cent ad valorem; veal, 1½ cents per pound.	Free.
Mutton and lamb	1½ cents per pound	Free.
Pork	Fresh, 1½ cents per pound; bacon and hams, 4 cents per pound; other pork, 25 per cent ad valorem.	
Sausage	Bologna, or frankfurter, free; other sausage, 25 per cent ad valorem.	Free.
Wool	Class 1, clothing, etc., wools: Unwashed, 11 cents per pound; washed, 22 cents; scoured, 33 cents. Class 2, combing, etc., wools: Unwashed, 12 cents per pound; washed, 12 cents; scoured, 36 cents. Class 3: Value not over 12 cents per pound, 12 cents; over 12 cents, 21 cents.	Free on and after Dec. 1, 1913.

STOCKS OF POTATOES, JANUARY 1, 1914.

COMPARISON WITH PRICES.

The yearly estimates of the amount of potatoes remaining in the growers' hands and the stocks in dealers' hands on January 1 in the important potato States indicate that a larger proportion of the marketable crop of potatoes was still in the hands of farmers on January 1, 1914, than had been the case for four years past. The proportion estimated to be in dealers' hands was smaller than for any year of the last four except January 1, 1912. The figures showed that the total estimated potato production of 1913 was below normal, but owing to the slow movement of the crop up to January 1 the supply for the remainder of the year will be almost normal. Distribution, however, seems to be unusually uneven. The holdings of potatoes are relatively large in the important producing States of Maine, Michigan, Wisconsin, and Minnesota, and relatively small in New York, Ohio, Indiana, Illinois, Iowa, and Kansas, which are important both as potato-producing and potato-consuming States.

In consequence of the firm holding by farmers, the price early in the season has been unusually high, being on December 1 about 17½ cents per bushel higher than a year ago and 16½ cents higher than three years ago, but 11½ cents lower than two years ago, when potatoes on January 1 were selling for 77½ cents per bushel and the supply was unusually short, owing to the drought of the previous year.

Present conditions do not seem to forecast material, if any, advance in prices in the important producing States this year; in 1911, when supplies were but moderately larger than now, and in 1913 the price movement after January 1 was downward instead of upward. The only other factor which may enter to change the experience of 1911 and 1913 is the somewhat different distribution of the crop which exists this year.

Southern growers who plant in the spring for the early market would seem to be justified from present conditions in putting out a normal acreage, but should not expect the big advance in prices which prevailed two years ago.

The estimates indicate that about 42.1 per cent of the marketable supply of potatoes of the 1913 crop remained in the hands of farmers and 9.5 per cent in the hands of dealers on January 1, in the important potato-growing States. These figures compare with 39.8 and 9.8 per cent similarly estimated a year ago; 33.1 and 8.6 per cent two years ago; 40.2 and 10.9 per cent three years ago; and 41.2 and 9.9 per cent four years ago. If, for the purpose of comparison, these percentages were applied to the estimates of total production, it would show total stocks of 123,000,000 bushels on January 1, 1914 (in the 19 States of Table 18), compared with 150,000,000 a year ago, 91,000,000 two years ago, 133,000,000 three years ago, and 142,000,000 four years ago. These figures would indicate that the quantity to be carried toward the close of the season will not be sufficient to cause depressed prices, as was the case particularly four years ago (in some States last year also), nor, on the other hand, will they be so scant as to cause so high prices as prevailed in the spring of 1912.

To show the relation between supplies and prices, Table 18 is given, showing for the past four years the production, stock on hand January 1, and the prices paid to producers on December 1 and the following March 1, in the important potato-growing States.

COMPARISON WITH IMPORTS.

The relation between imports of potatoes and production in this country may be observed in Table 9. In this table it appears at a glance that the extraordinary importation of nearly 14,000,000 bushels of potatoes, in the year beginning July 1, 1911, was in consequence of the extraordinary low production of that year. When an unusually large crop was harvested in the following year, the imports fell to only 337,230 bushels. It is apparent, also, that the imports of potatoes already received in this fiscal year are unusually large in comparison with the crop of 1913, which may be rated as low medium.

TABLE 9.—*Imports of potatoes.*

Year beginning July 1—	Imports.		United States production in calendar year.
	Bushels.	Value.	
			Bushels.
1909	353,208	$306,815	389,195,000
1910	218,984	235,847	349,032,000
1911	13,734,695	7,168,627	292,737,000
1912 (preliminary)	337,230	303,214	420,647,000
1913			331,525,000
MONTH, 1913.			
July	5,310	4,314	
August	10,411	7,766	
September	8,106	5,616	
October	472,052	202,356	
November	764,829	346,679	

WHEAT CROP OF THE "WORLD."

NOW EXCEEDS 4,000,000,000 BUSHELS.

A full statement of the estimated area and production of wheat for 1913 and also for the preceding two years, for all countries of the world for which information is obtainable, may be found in Table 19. Estimates of this sort have been made by the Bureau of Statistics (Agricultural Forecasts) for many years. The numbers expressing total production for these years have been assembled in Table 10. It appears that the world's production of wheat, as far as ascertainable, was 2,432,000,000 bushels in 1891; that the number reached 3,000,000,000 in 1902, when the total was 3,090,000,000 bushels; and that 4,000,000,000 was reached in 1913, when the total was 4,126,000,000 bushels.

TABLE 10.—*Total production of wheat in countries named in Table 19.*

Year.	Production.	Year.	Production.
	Bushels.		*Bushels.*
1891	2,432,322,000	1903	3,189,813,000
1892	2,481,805,000	1904	3,163,542,000
1893	2,559,174,000	1905	3,327,084,000
1894	2,660,557,000	1906	3,434,354,000
1895	2,593,312,000	1907	3,133,965,000
1896	2,506,320,000	1908	3,182,105,000
1897	2,236,268,000	1909	3,581,519,000
1898	2 948,305,000	1910	3,575,055,000
1899	2,783,885,000	1911	3,538,794,000
1900	2,640,751,000	1912	3,877,087,000
1901	2,955,975,000	1913	4,125,658,000
1902	3,090,116,000		

CROP-VALUE COMPARISONS.

The estimated total value of corn, wheat, oats, barley, rye, buckwheat, flaxseed, rice, potatoes, sweet potatoes, hay, tobacco, and lint cotton are given in Table 11; values are farm values on December 1 as estimated by the Department of Agriculture, except for cotton. For cotton, values for 1909 and 1911 are those given by the Bureau of the Census, Department of Commerce, for lint from the crops ginned in 1909–10 and 1911–12, respectively; for 1912 and 1913 the December farm price for cotton was applied to the Department of Agriculture's preliminary estimate of the production of lint cotton in 1912–13 and 1913–14, respectively.

TABLE 11.—*Estimated value in 1913 of crops considered by the United States Department of Agriculture, with comparisons.*

State.	Value of crops enumerated (000 omitted).				Value of all crops, 1909 (census). (000 omitted.)	Value of enumerated crops, 1909, compared with value of all crops.	Rank of State.			Value.	Value.
	1913	1912	1911	1909 (census).			Enumerated crops.		All crops.	1913 compared with 1912.	1913 compared with 1909.
							1913	1909	1909		
						P. ct.				*P. ct.*	*P. ct.*
Texas	$400,231	$409,974	$287,287	$244,721	$298,133	82	1	3	3	− 2.4	+63.5
Iowa	327,996	284,589	279,238	287,065	314,666	91	2	2	2	+15.3	+14.3
Illinois	295,046	290,071	318,000	342,861	372,270	92	3	1	1	+ 1.7	−13.9
Georgia	217,753	164,573	199,669	176,959	226,595	78	4	8	5	+32.3	+23.1
Ohio	212,434	190,821	215,866	197,288	230,338	86	5	4	4	+11.3	+ 7.7
Minnesota	194,178	160,615	176,759	168,706	193,451	87	6	10	11	+20.9	+15.1
Indiana	185,917	153,750	179,556	181,234	204,210	89	7	7	9	+20.9	+ 2.6
Missouri	174,520	197,470	187,302	188,524	220,664	85	8	6	6	−11.6	− 7.4
Pennsylvania	168,998	176,365	164,083	130,010	166,740	78	9	13	13	− 4.2	+30.0
Nebraska	162,078	141,634	153,335	173,512	196,126	88	10	9	10	+14.4	− 6.6
Alabama	156,175	132,752	135,083	108,095	144,287	75	11	20	18	+17.6	+44.5
Wisconsin	155,465	139,032	161,419	121,048	148,359	82	12	14	16	+11.8	+28.4
North Carolina	150,203	132,580	122,613	102,783	142,890	72	13	22	19	+13.3	+46.1
New York	148,767	152,533	161,785	132,620	209,168	63	14	12	8	− 2.5	+12.2
South Carolina	139,076	116,020	121,244	109,699	141,983	77	15	18	20	+19.9	+26.8

TABLE 11.—*Estimated value in 1913 of crops considered by the United States Department of Agriculture, with comparisons*—Continued.

State.	Value of crops enumerated. (000 omitted.)				Value of all crops, 1909 (census). (000 omitted.)	Value of enumerated crops, 1909, compared with value of all crops.	Rank.			1913 compared with 1912.	1913 compared with 1909.
							Enumerated crops.		All crops.		
	1913	1912	1911	1909 (census).			1913	1909	1909		
						P. ct.				*P. ct.*	*P. ct.*
Mississippi	130,622	114,609	103,565	107,054	147,316	73	16	21	17	+14.0	+22.0
Kansas	124,136	182,873	156,713	189,091	214,860	88	17	5	7	−32.1	−34.4
Michigan	122,555	116,209	149,148	114,808	162,005	71	18	15	14	+ 5.5	+ 6.7
Tennessee	114,249	107,496	111,046	93,341	120,706	77	19	23	24	+ 6.3	+22.4
Oklahoma	111,532	126,733	88,674	112,344	133,454	84	20	17	22	−12.0	− .7
Kentucky	110,654	116,848	110,159	114,202	138,973	82	21	16	21	− 5.3	− 3.1
North Dakota	105,356	155,110	130,664	168,292	180,636	93	22	11	12	−32.1	−37.4
Arkansas	103,132	97,312	92,421	86,611	119,419	73	23	24	25	+ 6.0	+19.1
Virginia	100,807	81,476	75,613	71,153	100,531	71	24	26	26	+23.7	+ 41.7
South Dakota	94,397	99,660	60,659	109,353	125,507	87	25	19	23	− 5.3	− 13.7
California	88,897	101,609	105,304	71,994	153,111	47	26	25	15	−12.5	+ 23.5
Louisiana	73,335	64,658	58,091	47,577	77,336	62	27	28	28	+13.4	+ 54.1
Washington	73,246	68,279	75,458	64,340	78,927	82	28	27	27	+ 7.3	+ 13.8
Colorado	43,149	38,846	35,309	31,416	50,975	62	29	31	29	+11.1	+ 37.3
West Virginia	42,213	41,865	31,139	27,749	40,375	69	30	34	32	+ 0.8	+ 52.1
Montana	41,214	40,419	40,207	22,394	29,715	75	31	36	38	+ 2.0	+ 81.0
Oregon	40,069	41,377	40,691	33,140	49,041	68	32	29	30	− 3.2	+ 20.9
Maine	35,553	35,573	39,670	27,836	39,318	71	33	33	34	− 0.1	+ 27.7
Idaho	35,294	33,499	40,019	28,816	34,358	84	34	32	36	+ 5.4	+ 22.5
Maryland	35,089	35,837	34,569	31,454	43,920	72	35	30	31	− 2.1	+ 11.6
New Jersey	30,337	29,782	28,193	23,396	40,341	58	36	35	33	+ 1.9	+ 29.7
Vermont	24,332	26,707	21,158	18,577	27,447	68	37	37	39	− 8.9	+ 31.0
Florida	19,688	16,997	18,203	14,932	36,142	41	38	38	35	+15.8	+ 31.9
Connecticut	18,930	21,543	20,181	14,872	22,488	66	39	40	40	−12.1	+ 27.3
Massachusetts	18,432	19,555	17,771	14,916	31,948	47	40	39	37	− 5.7	+ 23.6
Utah	17,698	17,446	15,969	13,682	18,485	74	41	41	41	+ 1.4	+ 29.4
Wyoming	12,851	13,732	14,669	7,508	10,02[illegible]	75	42	43	43	− 6.4	+ 71.2
New Hampshire	11,201	11,938	11,977	9,233	15,976	58	43	42	42	− 6.2	+ 21.3
Nevada	9,980	9,009	9,257	4,082	5,924	69	44	46	46	+10.8	+144.5
New Mexico	9,017	7,840	11,138	5,591	8,922	63	45	45	45	+15.0	+ 61.3
Arizona	8,818	7,511	7,448	3,993	5,497	73	46	47	47	+17.4	+120.8
Delaware	7,810	7,971	8,357	6,543	9,122	72	47	44	44	− 2.0	+ 19.4
Rhode Island	2,451	2,327	2,461	2,030	3,937	52	48	48	48	+ 5.3	+ 20.7
United States	4,906,881	4,735,425	[1] 4,632,740	[2] 4,357,595	5,486,615	79.4	.....	.....	......	+ 3.6	+ 12.6

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[1] Includes $800,000 for cotton in Arizona, California, Kansas, Kentucky, and New Mexico, not distributed by States.

[2] Includes $150,000 for cotton in Arizona, California, Kansas, Kentucky, and New Mexico, not distributed by States.

G. K. HOLMES,
Bureau of Statistics (Agricultural Forecasts).

TABLE 12.—*Cattle other than milch cows: Estimated number on farms, and value, Jan. 1, 1914, with comparisons, by States.*

State.	Number (000 omitted).				Value per head, Jan. 1.			Total value, Jan. 1 (000 omitted).		
	Jan. 1, 1914 (est.).		Jan. 1, 1913 (est.).	Apr. 15, 1910 (census).	1914	1913	1910	1914	1913	1910 [2]
	Per cent.[1]	Total.								
Maine	101	100	99	100	$23.40	$21.20	$16.90	$2,340	$2,099	$1,690
New Hampshire	99	65	66	67	26.80	24.00	20.30	1,742	1,584	1,360
Vermont	98	165	168	165	21.10	18.30	14.40	3,482	3,074	2,376
Massachusetts	101	82	81	80	23.10	19.90	16.70	1,894	1,612	1,336
Rhode Island	100	11	11	11	28.10	20.60	17.50	309	227	192
Connecticut	101	72	71	72	27.90	22.50	19.10	2,000	1,598	1,375
New York	100	876	876	913	27.20	22.00	18.20	23,827	19,272	16,617
New Jersey	103	68	66	69	30.50	25.10	21.40	2,074	1,657	1,477
Pennsylvania	103	632	614	653	28.30	23.60	19.20	17,886	14,490	12,538
Delaware	101	19	19	19	29.20	23.80	21.00	555	452	399
Maryland	99	119	120	121	29.40	24.60	21.10	3,499	2,952	2,553
Virginia	98	450	459	503	27.60	23.20	19.40	12,420	10,649	9,758
West Virginia	100	331	331	380	35.90	29.00	22.50	11,883	9,599	8,550
North Carolina	98	365	372	392	17.30	14.90	12.50	6,314	5,543	4,900
South Carolina	98	211	215	209	14.90	14.20	12.00	3,144	3,053	2,508
Georgia	99	660	667	674	12.70	11.00	10.30	8,382	7,337	6,942
Florida	96	735	766	729	13.70	12.20	10.30	10,070	9,345	7,509
Ohio	103	838	814	933	35.40	29.80	24.10	29,665	24,257	22,485
Indiana	103	707	686	729	33.90	30.10	24.50	23,967	20,649	17,860
Illinois	99	1,216	1,228	1,391	35.90	31.50	26.40	43,654	38,682	36,722
Michigan	101	680	673	731	28.10	22.10	18.50	19,108	14,873	13,524
Wisconsin	102	1,158	1,135	1,207	27.10	21.70	16.40	31,382	24,630	19,796
Minnesota	103	1,173	1,139	1,262	24.30	20.00	14.30	28,504	22,780	18,047
Iowa	98	2,555	2,607	3,041	39.20	33.00	22.20	100,156	86,031	67,510
Missouri	96	1,386	1,444	1,705	36.10	31.10	22.60	50,035	44,908	38,533
North Dakota	107	468	437	485	34.60	27.20	20.50	16,193	11,886	9,942
South Dakota	102	912	894	1,165	39.50	32.30	21.50	36,024	28,876	25,048
Nebraska	99	1,883	1,902	2,318	38.10	32.40	21.90	71,742	61,625	50,764
Kansas	88	1,565	1,778	2,343	36.90	33.40	23.70	57,748	59,385	55,529
Kentucky	95	527	555	591	28.80	25.90	19.90	15,178	14,374	11,761
Tennessee	94	498	530	600	21.40	16.90	13.80	10,657	8,957	8,280
Alabama	96	514	535	540	12.00	10.10	9.00	6,168	5,404	4,860
Mississippi	94	490	521	583	13.50	10.40	8.40	6,615	5,418	4,897
Louisiana	101	448	444	526	15.30	12.00	10.30	6,854	5,328	5,418
Texas	103	5,173	5,022	5,921	26.50	22.60	15.30	137,084	113,497	90,591
Oklahoma	95	1,097	1,155	1,423	33.40	27.60	19.20	36,640	31,878	27,322
Arkansas	95	475	500	602	15.80	12.20	9.00	7,505	6,100	5,418
Montana	105	753	717	866	46.40	38.40	27.40	34,939	27,533	23,728
Wyoming	108	546	506	734	49.40	38.80	26.40	26,972	19,633	19,378
Colorado	103	949	921	983	40.00	34.10	23.00	37,960	31,406	22,609
New Mexico	103	918	891	1,031	32.70	29.00	17.40	30,019	25,839	17,939
Arizona	95	739	778	796	32.50	29.20	19.30	24,018	22,718	15,363
Utah	101	356	352	336	35.50	28.50	18.30	12,638	10,032	6,149
Nevada	101	437	433	433	38.90	33.30	20.70	16,999	14,419	8,963
Idaho	104	354	340	368	41.20	33.50	21.40	14,585	11,390	7,875
Washington	107	199	186	216	35.70	30.50	19.90	7,104	5,673	4,298
Oregon	104	470	452	552	38.00	32.00	18.50	17,860	14,464	10,212
California	97	1,410	1,454	1,610	33.00	29.20	20.10	46,530	42,457	32,361
United States	99.5	35,855	36,030	41,178	31.13	26.36	19.07	1,116,333	949,645	785,261

[1] Compared with Jan. 1, 1913.

[2] Based on census numbers on Apr. 15 and the Department of Agriculture's estimated farm value per head Jan. 1, 1910.

Table 13.—*Milch cows: Estimated number on farms, and value, Jan. 1, 1914, with comparisons, by States.*

State.	Number (000 omitted).				Value per head, Jan. 1.			Total value, Jan. 1 (000 omitted).		
	Jan. 1, 1914 (est.).		Jan. 1, 1913 (est.).	Apr. 15, 1910 (census).	1914	1913	1910	1914	1913	1910[2]
	Per cent.[1]	Total.								
Maine	101	159	157	157	$47.50	$46.00	$33.00	$7,552	$7,222	$5,181
New Hampshire	100	96	96	101	53.50	48.00	36.20	5,136	4,608	3,656
Vermont	100	265	265	265	47.50	44.50	34.20	12,588	11,792	9,063
Massachusetts	98	162	165	172	59.00	51.00	42.00	9,558	8,415	7,224
Rhode Island	99	23	23	23	70.00	52.50	43.80	1,610	1,208	1,007
Connecticut	102	120	118	123	58.00	51.70	41.00	6,960	6,101	5,043
New York	100	1,465	1,465	1,510	57.00	50.00	39.50	83,505	73,250	59,645
New Jersey	100	146	146	154	67.00	55.20	47.50	9,782	8,059	7,315
Pennsylvania	100	943	943	934	58.40	46.60	39.00	55,071	43,944	36,426
Delaware	103	39	38	36	52.00	42.20	38.00	2,028	1,604	1,368
Maryland	101	170	168	167	53.80	42.60	37.30	9,146	7,157	6,229
Virginia	99	342	345	356	42.00	34.00	29.70	14,364	11,730	10,573
West Virginia	101	232	230	240	50.00	42.00	35.00	11,600	9,660	8,400
North Carolina	99	309	312	309	35.10	30.10	25.50	10,846	9,391	7,880
South Carolina	100	185	185	181	34.20	32.50	28.90	6,327	6,012	5,231
Georgia	100	402	402	406	31.30	28.50	25.00	12,583	11,457	10,150
Florida	104	128	123	116	38.00	36.00	32.50	4,864	4,428	3,770
Ohio	102	886	869	905	60.00	50.00	42.80	53,160	43,450	38,734
Indiana	101	640	634	634	53.90	45.70	41.00	34,496	28,974	25,994
Illinois	101	1,017	1,007	1,050	58.20	51.00	42.80	59,189	51,357	44,940
Michigan	100	798	798	767	59.70	45.00	39.50	47,641	35,910	30,296
Wisconsin	103	1,549	1,504	1,473	59.90	47.70	36.60	92,785	71,741	53,912
Minnesota	103	1,163	1,129	1,085	55.00	45.00	33.00	63,965	50,805	35,805
Iowa	101	1,350	1.337	1.407	60.50	50.30	36.00	81,675	67,251	50,652
Missouri	100	789	789	856	54.00	45.30	34.80	42,606	35,742	29,789
North Dakota	110	305	277	259	59.00	47.00	33.90	17,995	13.019	8.780
South Dakota	109	419	384	370	61.00	48.00	33.00	25,559	18,432	12,210
Nebraska	101	613	607	614	60.70	49.60	35.00	37,209	30,107	21,490
Kansas	100	698	698	736	57.50	49.20	36.90	40,135	34,342	27,158
Kentucky	98	382	390	410	44.50	38.90	32.70	16,999	15,132	13.407
Tennessee	95	348	366	397	41.40	33.10	27.50	14.407	12.115	10,918
Alabama	98	288	396	392	32.40	27.00	23.00	12,571	10.692	9,016
Mississippi	97	421	434	430	34.00	27.70	23.50	14,314	12,022	10,105
Louisiana	97	263	271	279	34.00	29.00	24.30	8.942	7,859	6.780
Texas	103	1,065	1,034	1.014	45.60	39.90	29.50	48.564	41,257	29,913
Oklahoma	100	484	484	531	50.30	43.00	31.50	24,345	20,812	16,726
Arkansas	96	376	392	426	37.50	28.60	22.00	14,100	11,211	9,372
Montana	110	104	95	77	70.50	61.00	46.50	7,332	5,795	3,580
Wyoming	114	41	36	33	74.50	58.00	43.70	3,054	2,088	1,442
Colorado	108	186	172	145	63.00	53.80	41.00	11,718	9,254	5,945
New Mexico	110	62	56	51	55.00	47.80	38.80	3,410	2,677	1,979
Arizona	108	37	34	29	64.00	58.00	43.00	2,368	1,972	1,247
Utah	103	88	85	76	59.00	49.00	34.00	5,192	4,165	2,584
Nevada	108	22	20	17	65.10	52.00	44.00	1,432	1,040	748
Idaho	110	112	102	86	69.80	59.60	41.40	7,818	6,079	3,560
Washington	107	234	219	186	74.00	62.50	41.80	17,316	13,688	7,775
Oregon	105	196	187	173	65.00	56.00	39.60	12,740	10.472	6,851
California	101	515	510	467	62.00	53.50	38.40	31.930	27,285	17.933
United States	101.2	20,737	20,497	20,625	53.94	45.02	35.29	1,118,487	922,783	727,802

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[1] Compared with Jan. 1, 1913.

[2] Based on census numbers on Apr. 15 and the Department of Agriculture's estimated farm value per head Jan. 1, 1910.

TABLE 14.—*Sheep: Estimated number of farms, and value, Jan. 1, 1914, with comparisons, by States.*

State.	Number (000 omitted).				Value per head, Jan. 1—			Total value, Jan. 1 (000 omitted).		
	Jan. 1, 1914 (est.)		Jan. 1, 1913 (est.).	Apr. 15, 1910 (census).	1914	1913	1910	1914	1913	1910[2]
	Per ct.[1]	Total.								
Maine	95	177	186	206	$4.30	$4.20	$3.70	$761	$781	$762
New Hampshire	92	39	42	44	4.40	4.90	3.70	172	206	163
Vermont	95	111	117	119	4.80	4.60	4.00	533	538	476
Massachusetts	90	31	34	33	5.30	4.80	4.20	164	163	139
Rhode Island	100	7	7	7	5.40	5.10	4.20	38	36	29
Connecticut	97	20	21	22	5.40	5.20	4.70	108	109	103
New York	100	875	875	930	5.40	5.00	5.00	4,725	4,375	4,650
New Jersey	99	31	31	31	5.60	5.30	5.20	174	164	161
Pennsylvania	97	839	865	883	4.90	5.00	4.80	4,111	4,325	4,238
Delaware	100	8	8	8	5.10	4.70	4.60	41	38	37
Maryland	99	223	225	237	5.00	4.60	4.70	1,115	1,035	1,114
Virginia	98	735	750	805	4.50	4.00	3.90	3,308	3,000	3,140
West Virginia	96	788	821	910	4.30	4.30	4.30	3,388	3,530	3,913
North Carolina	98	177	181	214	3.20	3.10	2.60	566	561	556
South Carolina	98	33	34	38	2.60	2.80	2.40	86	95	91
Georgia	98	166	169	188	2.10	1.90	2.20	349	321	414
Florida	99	118	119	114	1.90	2.10	2.00	224	250	228
Ohio	95	3,263	3,435	3,909	4.30	4.10	4.80	14,031	14,084	18,763
Indiana	94	1,238	1,317	1,337	4.90	4.60	5.20	6,066	6,058	6,952
Illinois	95	984	1,036	1,060	5.00	5.10	5.30	4,920	5,284	5,618
Michigan	99	2,118	2,139	2,306	4.60	4.30	4.70	9,743	9,198	10,838
Wisconsin	96	789	822	930	4.70	4.50	4.50	3,708	3,699	4,185
Minnesota	100	570	570	638	4.40	4.40	4.00	2,508	2,508	2,552
Iowa	100	1,249	1,249	1,146	5.30	5.10	5.30	6,620	6,370	6,074
Missouri	95	1,568	1,650	1,811	4.20	4.20	4.40	6,586	6,930	7,968
North Dakota	95	278	293	293	4.20	3.90	4.00	1,168	1,143	1,172
South Dakota	104	617	593	611	4.00	4.10	4.00	2,468	2,431	2,444
Nebraska	98	374	382	294	4.50	4.40	4.40	1,683	1,681	1,294
Kansas	100	316	316	272	4.50	4.60	4.70	1,422	1,454	1,278
Kentucky	96	1,267	1,320	1,363	4.20	4.00	4.00	5,321	5,280	5,452
Tennessee	95	688	724	795	3.40	3.10	3.40	2,339	2,244	2,703
Alabama	94	124	132	143	2.40	2.10	2.00	298	277	286
Mississippi	97	202	208	195	2.30	2.20	1.90	465	458	370
Louisiana	105	180	171	178	2.20	2.00	1.90	396	342	338
Texas	96	2,052	2,073	1,809	2.90	2.90	2.90	5,951	6,012	5,246
Oklahoma	105	75	71	62	4.00	3.60	3.30	300	256	205
Arkansas	95	124	130	144	2.60	2.40	2.30	322	312	331
Montana	84	4,293	5,111	5,381	3.70	3.70	4.20	15,884	18,911	22,600
Wyoming	100	4,472	4,472	5,397	4.10	4.10	4.40	18,335	18,335	23,747
Colorado	96	1,668	1,737	1,426	3.70	3.60	3.80	6,172	6,253	5,419
New Mexico	92	3,036	3,300	3,347	3.00	3.10	2.90	9,108	10,230	9,706
Arizona	102	1,601	1,570	1,227	3.60	3.70	3.70	5,764	5,809	4,540
Utah	99	1,970	1,990	1,827	3.90	4.10	4.10	7,683	8,159	7,491
Nevada	102	1,517	1,487	1,155	4.50	4.00	3.70	6,826	5,948	4,274
Idaho	101	2,981	2,951	3,011	4.20	4.00	4.70	12,520	11,804	14,152
Washington	101	506	501	476	4.40	4.20	3.90	2,226	2,104	1,856
Oregon	101	2,670	2,644	2,699	3.90	3.80	3.70	10,413	10,047	9,986
California	98	2,551	2,603	2,417	3.80	3.70	3.30	9,694	9,631	7,976
United States	96.6	49,719	51,482	52,448	4.04	3.94	4.12	200,803	202,779	216,030

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[1] Compared with Jan. 1, 1913.

[2] Based on census numbers on Apr. 15 and the Department of Agriculture's estimated farm value per head Jan. 1, 1910.

TABLE 15.—*Swine: Estimated number on farms, and value, Jan. 1, 1914, with comparisons, by States.*

State.	Number (000 omitted).				Value per head, Jan. 1			Total value, Jan. 1 (000 omitted).		
	Jan. 1, 1914 (est.).		Jan. 1, 1913 (est.).	Apr 15, 1910 (census)	1914	1913	1910	1914	1913	1910[2]
	Per ct.[1]	Total.								
Maine	96	97	101	87	$15.80	$12.90	$11.50	$1,533	$1,303	$1,000
New Hampshire	98	51	52	45	14.80	12.70	11.50	755	660	518
Vermont	99	106	107	95	14.10	12.20	10.00	1,495	1,305	950
Massachusetts	92	106	115	103	14.50	13.00	11.50	1,537	1,495	1,184
Rhode Island	100	14	14	14	15.20	14.50	12.50	213	203	175
Connecticut	99	57	58	52	16.30	14.00	12.50	929	812	650
New York	99	753	761	666	14.50	12.60	11.50	10,918	9,589	7,659
New Jersey	99	158	160	147	13.60	13.00	12.00	2,149	2,080	1,764
Pennsylvania	100	1,130	1,130	978	13.80	12.50	9.50	15,594	14,125	9,291
Delaware	100	58	58	49	10.30	11.20	8.70	597	650	426
Maryland	99	332	335	302	10.50	9.80	8.90	3,486	3,283	2,688
Virginia	104	869	836	798	8.30	7.00	6.50	7,213	5,852	5,187
West Virginia	103	367	356	328	10.10	9.00	7.70	3,707	3,204	2,526
North Carolina	102	1,362	1,335	1,228	9.00	7.70	7.20	12,258	10,280	8,842
South Carolina	102	780	765	665	9.10	8.50	7.20	7,098	6,502	4,788
Georgia	103	1,945	1,888	1,784	8.20	7.10	7.00	15,949	13,405	12,488
Florida	103	904	878	810	6.00	5.90	4.80	5,424	5,180	3,888
Ohio	102	3,467	3,399	3,106	11.30	10.80	10.70	39,177	36,709	33,234
Indiana	107	3,969	3,709	3,614	10.30	9.80	10.00	40,881	36,348	36,140
Illinois	101	4,358	4,315	4,686	10.80	10.50	10.90	47,066	45,308	51,077
Michigan	100	1,313	1,313	1,246	12.30	10.80	10.50	16,150	14,180	13,083
Wisconsin	101	2,050	2,030	1,809	13.00	11.60	11.80	26,650	23,548	21,346
Minnesota	84	1,430	1,702	1,520	14.00	12.70	11.50	20,020	21,615	17,480
Iowa	80	6,976	8,720	7,546	12.60	12.00	11.30	87,898	104,640	85,270
Missouri	104	4,250	4,087	4,438	8.50	8.50	7.90	36,125	34,740	35,060
North Dakota	117	428	366	332	13.20	13.70	11.00	5,650	5,014	3,652
South Dakota	88	1,039	1,181	1,010	11.30	11.00	11.10	11,741	12,991	11,211
Nebraska	85	3,228	3,798	3,436	11.80	11.40	11.00	38,090	43,297	37,796
Kansas	90	2,350	2,611	3,000	10.00	10.40	10.00	23,500	27,154	30,000
Kentucky	92	1,507	1,638	1,492	7.70	7.10	6.80	11,604	11,630	10,146
Tennessee	93	1,390	1,495	1,388	8.50	7.40	6.50	11,815	11,063	9,022
Alabama	102	1,485	1,456	1,267	8.50	6.80	6.00	12,622	9,901	7,602
Mississippi	99	1,467	1,482	1,292	8.10	6.90	5.50	11,883	10,226	7,106
Louisiana	99	1,398	1,412	1,328	8.00	7.00	5.50	11,184	9,884	7,304
Texas	105	2,618	2,493	2,336	8.60	8.40	6.60	22,515	20,941	15,418
Oklahoma	102	1,352	1,325	1,839	8.40	8.90	7.70	11,357	11,792	14,160
Arkansas	98	1,498	1,529	1,519	7.40	6.70	4.80	11,085	10,244	7,291
Montana	120	184	153	99	11.90	11.90	10.10	2,190	1,821	1,000
Wyoming	125	51	41	34	12.40	11.00	8.50	632	451	289
Colorado	100	205	205	179	10.50	11.00	9.50	2,152	2,255	1,700
New Mexico	108	56	52	46	10.10	9.60	8.50	566	499	391
Arizona	105	24	23	17	9.60	11.50	9.50	230	264	162
Utah	105	85	81	64	10.90	11.00	9.00	926	891	576
Nevada	104	33	32	23	12.60	11.00	9.00	416	352	207
Idaho	108	252	233	178	10.70	10.30	8.70	2,696	2,400	1,549
Washington	110	284	258	206	12.70	11.30	9.40	3,607	2,915	1,936
Oregon	112	300	268	218	11.00	9.50	8.20	3,300	2,546	1,788
California	97	797	822	767	10.50	9.20	8.20	8,368	7,562	6,289
United States.	96.3	58,933	61,178	58,186	10.40	9.86	9.17	612,951	603,109	533,309

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[1] Compared with Jan. 1, 1913.

[2] Based on census numbers on Apr. 15 and the Department of Agriculture's estimated farm value per head Jan. 1, 1910.

TABLE 16.—*Horses: Estimated number on farms, and value, Jan. 1, 1914, with comparisons, by States.*

State.	Number (000 omitted).				Value per head, Jan. 1.			Total value, Jan. 1 (000 omitted).		
	Jan. 1, 1914 (est.).		Jan. 1, 1913 (est.).	Apr. 15, 1910 (census).	1914	1913	1910	1914	1913	1910[2]
	Per ct.[1]	Total.								
Maine	111	111	110	108	$150.00	$139.00	$125.00	$16,650	$15,290	$13,500
New Hampshire	102	47	46	46	137.00	123.00	106.00	6,439	5,658	4,876
Vermont	105	88	84	81	129.00	127.00	106.00	11,352	10,668	8,586
Massachusetts	101	65	64	64	161.00	146.00	128.00	10,465	9,344	8,192
Rhode Island	103	10	10	9	156.00	144.00	129.00	1,560	1,440	1,161
Connecticut	100	47	47	46	153.00	141.00	126.00	7,191	6,627	5,796
New York	101	615	609	591	145.00	137.00	125.00	89,175	83,433	73,875
New Jersey	101	91	90	89	157.00	147.00	134.00	14,287	13,230	11,926
Pennsylvania	101	584	578	550	139.00	133.00	132.00	81,176	76,874	72,600
Delaware	102	35	34	33	106.00	102.00	106.00	3.710	3,468	3,498
Maryland	101	165	163	156	119.00	116.00	108.00	19,635	18,908	16,848
Virginia	103	350	340	330	114.00	106.00	107.00	39,900	36,040	35,310
West Virginia	103	190	184	180	122.00	116.00	112.00	23,180	21,344	20,160
North Carolina	102	180	176	166	139.00	128.00	121.00	25,020	22,528	20,086
South Carolina	102	85	83	80	144.00	140.00	127.00	12,240	11,620	10,160
Georgia	102	128	125	120	131.00	123.00	125.00	16,768	15,375	15,000
Florida	104	55	53	46	122.00	118.00	109.00	6,710	6,254	5,014
Ohio	101	901	892	910	132.00	130.00	129.00	118,932	115,960	117,390
Indiana	101	854	846	814	116.00	117.00	122.00	99,064	98,982	99,308
Illinois	101	1,497	1,482	1,453	113.00	120.00	124.00	169,161	177,840	180,172
Michigan	102	653	640	610	139.00	137.00	126.00	90,767	87,680	76,860
Wisconsin	102	678	665	615	136.00	131.00	121.00	92,208	87,115	74,415
Minnesota	103	847	822	753	125.00	123.00	111.00	105,875	101,106	83,583
Iowa	101	1,584	1,568	1,492	118.00	120.00	120.00	186,912	188,160	179,040
Missouri	101	1,095	1,084	1,073	98.00	101.00	103.00	107,310	109,484	110,519
North Dakota	105	748	712	651	112.00	124.00	114.00	83,776	88,288	74,214
South Dakota	104	730	702	669	96.00	105.00	105.00	70,080	73,710	70,245
Nebraska	102	1,048	1,027	1,008	94.00	101.00	108.00	98,512	103,727	108,864
Kansas	101	1,110	1,099	1,147	93.00	103.00	107.00	103,230	113,197	122,729
Kentucky	100	443	443	443	103.00	104.00	105.00	45,629	46,072	46,515
Tennessee	99	346	350	350	116.00	115.00	112.00	40,136	40,250	39,200
Alabama	102	149	146	136	113.00	106.00	95.00	16,837	15,476	12,920
Mississippi	102	241	236	216	95.00	92.00	85.00	22,895	21,712	18,360
Louisiana	102	191	187	181	85.00	87.00	79.00	16,235	16,269	14,299
Texas	103	1,216	1,181	1,170	80.00	82.00	73.00	97,280	96,842	85,410
Oklahoma	101	766	758	743	85.00	84.00	81.00	65,110	63,672	60,183
Arkansas	101	273	270	255	93.00	89.00	82.00	25,389	24,030	20,910
Montana	105	372	354	316	102.00	93.00	80.00	37,944	32,922	25,280
Wyoming	109	171	157	156	79.00	76.00	83.00	13,509	11,932	12,948
Colorado	105	340	324	294	83.00	87.00	85.00	28,220	28,188	24,990
New Mexico	103	197	191	179	55.00	58.00	47.00	10,835	11,078	8,413
Arizona	104	112	108	100	73.00	78.00	62.00	8,176	8,424	6,200
Utah	104	140	135	116	91.00	93.00	85.00	12,740	12,555	9.860
Nevada	102	76	75	68	78.00	87.00	78.00	5,928	6,525	5,304
Idaho	105	234	223	198	96.00	100.00	102.00	22,464	22,300	20,196
Washington	102	305	299	281	106.00	110.00	108.00	32,330	32,890	30,348
Oregon	103	301	292	272	96.00	99.00	103.00	28,896	28,908	28,016
California	99	498	503	469	100.00	109.00	105.00	49,800	54,827	49,245
United States	101.9	20,962	20,567	19.833	109.32	110.77	108.03	2,291,638	2,278,222	2,142.524

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[1] Compared with Jan. 1, 1913.

[2] Based on Census numbers on Apr. 15 and the Department of Agriculture's estimated farm value per head Jan 1, 1910.

TABLE 17.—*Mules: Estimated number on farms and value, Jan. 1, 1914, with comparisons, by States.*

States.	Number (000 omitted).				Value per head Jan. 1.			Total value, Jan. 1 (000 omitted).		
	Jan. 1, 1914 (est.).		Jan. 1, 1913 (est.).	Apr. 15, 1910 (census).	1914	1913	1910	1914	1913	1910[2]
	Per ct.[1]	Total.								
Maine	......	......	......	......	......	......	......	......	......	......
New Hampshire	......	......	......	......	......	......	......	......	......	......
Vermont	......	......	......	......	......	......	......	......	......	......
Massachusetts	......	......	......	......	......	......	......	......	......	......
Rhode Island	......	......	......	......	......	......	......	......	......	......
Connecticut	......	......	......	......	......	......	......	......	......	......
New York	102	4	4	4	$154.00	$157.00	$132.00	$616	$628	$528
New Jersey	102	4	4	4	177.00	169.00	155.00	708	676	620
Pennsylvania	102	45	44	44	148.00	149.00	145.00	6,660	6,556	6,380
Delaware	103	6	6	6	126.00	125.00	125.00	756	750	750
Maryland	103	24	23	23	143.00	142.00	130.00	3,432	3,266	2,990
Virginia	102	61	60	60	136.00	128.00	130.00	8,296	7,680	7,800
West Virginia	100	12	12	12	131.00	126.00	120.00	1,572	1,512	1,440
North Carolina	103	192	186	175	160.00	148.00	137.00	30,720	27,528	23,975
South Carolina	102	171	168	156	167.00	171.00	158.00	28,557	28,728	24,648
Georgia	103	319	310	295	161.00	151.00	157.00	51,359	46,810	46,315
Florida	104	27	26	23	168.00	152.00	155.00	4,536	3,952	3,565
Ohio	100	24	24	23	132.00	131.00	125.00	3,168	3,144	2,875
Indiana	102	86	84	82	121.00	122.00	126.00	10,406	10,248	10,332
Illinois	99	148	149	148	121.00	131.00	131.00	17,908	19,519	19,388
Michigan	102	4	4	4	133.00	139.00	122.00	532	556	488
Wisconsin	100	3	3	3	135.00	131.00	115.00	405	393	345
Minnesota	102	6	6	6	134.00	128.00	114.00	804	768	684
Iowa	102	57	56	56	123.00	124.00	123.00	7,011	6,944	6,888
Missouri	100	326	326	343	112.00	117.00	119.00	36,512	38,142	40,817
North Dakota	103	8	8	8	130.00	141.00	130.00	1,040	1,128	1,040
South Dakota	102	14	14	12	110.00	118.00	121.00	1,540	1,652	1,452
Nebraska	100	84	84	83	105.00	112.00	119.00	8,820	9,408	9,877
Kansas	100	222	222	208	105.00	114.00	116.00	23,310	25,308	24,128
Kentucky	100	229	229	225	118.00	120.00	118.00	27,022	27,480	26,550
Tennessee	98	270	276	276	127 00	129.00	123.00	34,290	35,604	33,948
Alabama	103	278	270	247	135.00	131.00	122.00	37,530	35,370	30,134
Mississippi	102	286	280	256	115.00	114.00	113.00	32,890	31,920	28,928
Louisiana	99	132	133	132	128.00	127.00	116.00	16,896	16,891	15,312
Texas	104	753	724	676	109.00	110.00	99.00	82,077	79,640	66,924
Oklahoma	100	269	269	257	104.00	107.00	105.00	27,976	28,783	26,985
Arkansas	101	235	233	222	114.00	115.00	109.00	26,790	26,795	24,198
Montana	101	4	4	4	106.00	109.00	102.00	424	436	408
Wyoming	105	2	2	2	113.00	109.00	106.00	226	218	212
Colorado	102	17	17	15	101.00	104.00	105.00	1,717	1,768	1,575
New Mexico	100	15	15	15	92.00	90.00	79.00	1,380	1,350	1,185
Arizona	111	6	5	4	144.00	119.00	108.00	864	595	432
Utah	100	2	2	2	82.00	92.00	80.00	164	184	160
Nevada	110	3	3	3	79.00	95.00	79.00	237	285	237
Idaho	104	4	4	4	103.00	108.00	116.00	412	432	464
Washington	103	14	14	12	116.00	117.00	121.00	1,624	1,638	1,452
Oregon	104	10	10	10	107.00	107.00	108.00	1,070	1,070	1,080
California	100	73	73	70	120.00	130.00	122.00	8,760	9,490	8,540
United States	101.4	4,449	4,386	4,210	123.85	124.31	120.20	551,017	545,245	506,049

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[1] Compared with Jan. 1, 1913.

[2] Based on Census numbers on Apr. 15 and the Department of Agriculture's estimated farm value per head Jan. 1, 1910.

TABLE 18.—*Stocks of potatoes, Jan. 1, 1914.*

State and year.	Total production, bushels (000 omitted).	Stock in growers' hands, Jan. 1.		Stock in dealers' hands, Jan. 1.		Total stock, bushels (000 omitted).	Price per bushel—	
		Per cent of crops.	Bushels (000 omitted).	Per cent of crops.	Bushels (000 omitted).		Dec. 1.	Mar. 1.
New England:							*Cents.*	*Cents.*
1913-14	39,102	46	17,874	11	4,388	22,262	61	....
1912-13	35,592	48	17,084	7	2,491	19,575	59	54
1911-12	30,925	48	14,844	6	1,856	16,700	82	112
1910-11	41,870	52	21,772	12	5,024	26,796	47	43
1909-10	41,246	50	20,623	7	2,887	23,510	53	45
New York:								
1913-14	26,640	55	14,630	4	1,064	15,694	80	....
1912-13	38,160	47	17,935	4	1,526	19,461	58	63
1911-12	27,750	35	9,712	5	1,388	11,100	90	109
1910-11	40,290	48	19,339	6	2,417	21,756	48	40
1909-10	48,598	43	20,897	7	3,402	24,299	50	50
Pennsylvania:								
1913-14	23,320	38	8,854	11	2,563	11,417	80	....
1912-13	28,885	33	9,532	8	2,311	11,843	57	62
1911-12	15,120	23	3,478	5	756	4,234	93	115
1910-11	24,200	33	7,986	10	2,420	10,406	52	52
1909-10	21,741	30	6,522	8	1,739	8,261	65	60
New Jersey:								
1913-14	8,930	6	534	2	178	712	82	....
1912-13	9,936	13	1,292	3	298	1,590	66	71
1911-12	6,132	6	368	4	245	613	105	114
1910-11	9,135	13	1,188	5	457	1,645	65	60
1909-10	8,057	20	1,611	6	483	2,094	82	78
Ohio:								
1913-14	10,240	26	2,652	10	1,020	3,672	85	....
1912-13	20,832	31	6,459	12	2,500	8,959	53	58
1911-12	12,350	25	3,088	7	864	3,952	84	114
1910-11	17,220	36	6,199	14	2,411	8,610	51	49
1909-10	20,323	32	6,503	12	2,439	8,942	56	53
Indiana:								
1913-14	3,975	30	1,200	16	640	1,840	84	....
1912-13	9,918	31	3,075	16	1,587	4,662	50	54
1911-12	5,162	22	1,136	10	516	1,652	87	116
1910-11	8,148	34	2,770	16	1,304	4,074	50	49
1909-10	8,906	35	3,117	16	1,425	4,542	52	53
Illinois:								
1913-14	5,750	21	1,218	5	290	1,508	89	....
1912-13	13,837	17	2,352	11	1,522	3,874	60	62
1911-12	6,900	20	1,380	10	1,035	2,415	90	113
1910-11	10,950	28	3,066	12	1,533	4,599	59	62
1909-10	12,166	30	3,650	11	1,825	5,475	61	60
Michigan:								
1913-14	33,600	49	16,964	12	4,032	20,996	55	....
1912-13	36,750	51	18,742	11	4,042	22,784	41	38
1911-12	31,020	41	12,718	10	3,102	15,820	71	89
1910-11	36,750	43	15,802	12	4,410	20,212	31	30
1909-10	38,244	51	19,604	11	4,207	23,811	35	29
Wisconsin:								
1913-14	32,155	53	17,066	10	3,220	20,286	54	....
1912-13	34,920	51	14,809	11	3,841	18,650	34	32
1911-12	32,480	37	12,018	11	3,573	15,591	62	85
1910-11	26,600	48	12,768	11	2,926	15,694	38	35
1909-10	31,968	45	14,386	10	3,197	17,583	38	32
Minnesota:								
1913-14	30,250	37	11,174	13	3,926	15,100	52	....
1912-13	33,075	41	13,561	15	5,161	18,722	28	28
1911-12	25,875	32	8,280	12	3,105	11,385	58	84
1910-11	3,420	34	4,563	15	2,013	6,576	64	59
1909-10	26,803	45	12,061	10	2,680	14,741	35	34
Iowa:								
1913-14	7,200	20	1,440	2	144	4,320	82	....
1912-13	18,966	31	5,879	15	2,845	8,724	46	50
1911-12	12,876	15	1,931	10	1,288	3,219	73	110
1910-11	12,384	20	2,477	12	1,486	3,963	60	61
1909-10	14,710	31	4,560	15	2,206	6,766	55	56
Nebraska:								
1913-14	5,664	27	1,539	8	456	2,095	78	....
1912-13	9,440	32	3,021	8	755	3,776	51	52
1911-12	6,032	25	1,508	10	603	2,111	92	124
1910-11	6,900	30	2,070	12	828	2,898	84	81
1909-10	8,118	33	2,679	15	1,218	3,897	60	65

TABLE 18.—*Stocks of potatoes, Jan. 1, 1914*—Continued.

State and year.	Total production, bushels (000 omitted).	Stock in growers' hands, Jan. 1.		Stock in dealers' hands, Jan. 1.		Total stock, bushels (000 omitted).	Price per bushel—	
		Per cent of crops.	Bushels (000 omitted).	Per cent of crops.	Bushels (000 omitted).		Dec. 1.	Mar. 1.
Kansas:							*Cents.*	*Cents.*
1913-14	2,920	10	290	8	232	522	91	....
1912-13	5,740	19	1,001	14	804	1,895	73	76
1911-12	1,760	11	194	7	123	317	106	132
1910-11	4,674	14	654	8	374	1,028	90	92
1909-10	5,647	20	1,129	13	734	1,863	79	85
Colorado:								
1913-14	9,200	55	5,060	7	644	5,704	65	....
1912-13	8,075	60	4,845	6	484	5,329	41	43
1911-12	3,150	45	1,418	8	252	1,670	99	100
1910-11	8,600	50	4,300	10	860	5,160	55	61
1909-10	11,781	48	5,655	8	942	6,597	57	59
Total above:								
1913-14	238,946	42.1	100,495	9.5	22,797	123,292	66.2	....
1912-13	304,126	39.8	119,678	9.8	167,149	149,845	48.6	47.7
1911-12	217,532	33.1	72,072	8.6	18,706	90,778	77.6	101.4
1910-11	261,141	40.2	104,954	10.9	28,457	138,411	49.5	46.9
1909-10	298,308	41.2	122,997	9.9	29,384	142,381	50.0	47.3

TABLE 19.—*Wheat crop of countries named, 1911–1913.*

Country.	Area.			Production.		
	1911	1912	1913	1911	1912	1913
NORTH AMERICA.						
United States	*Acres.* 49,543,000	*Acres.* 45,814,000	*Acres.* 50,184,000	*Bushels.* 621,338,000	*Bushels.* 730,267,000	*Bushels.* 763,380,000
Canada:						
New Brunswick	13,000	....	(1)	270,000	....	(1)
Ontario	941,000	....	(1)	19,252,000	....	(1)
Manitoba	2,980,000	(1)	2,804,000	60,275,000	(1)	53,331,000
Saskatchewan	4,705,000	....	5,720,000	97,665,000	....	121,559,000
Alberta	1,617,000	....	1,512,000	36,143,000	....	34,372,000
Other	121,000	....	979,000	2,313,000	....	22,455,000
Total Canada	10,377,000	10,997,000	11,015,000	215,918,000	224,159,000	231,717,000
Mexico	(1)	(1)	(1)	12,000,000	12,000,000	10,000,000
Total	....	....	....	849,256,000	966,426,000	1,005,097,000
SOUTH AMERICA.						
Argentina	15,452,000	17,042,000	17,096,000	145,981,000	166,190,000	198,414,000
Chile	968,000	1,093,000	(1)	18,184,000	22,468,000	21,000,000
Uruguay	637,000	799,000	(1)	6,009,000	8,757,000	9,000,000
Total	....	....	....	170,174,000	197,415,000	228,414,000
EUROPE.						
Austria-Hungary:						
Austria	3,003,000	3,114,000	2,998,000	58,865,000	69,712,000	60,123,000
Hungary proper	8,354,000	8,748,000	7,813,000	174,889,000	173,328,000	149,774,000
Croatia-Slavonia	808,000	833,000	837,000	15,188,000	11,314,000	16,899,000
Bosnia-Herzegovina	218,000	247,000	(1)	2,941,000	2,993,000	2,572,000
Total Austria-Hungary	12,383,000	12,942,000	....	251,883,000	257,347,000	229,368,000

[1] No data.

TABLE 19.—*Wheat crop of countries named, 1911–1913*—Continued.

Country.	Area.			Production.		
	1911	1912	1913	1911	1912	1913
EUROPE—continued.	*Acres.*	*Acres.*	*Acres.*	*Bushels.*	*Bushels.*	*Bushels.*
Belgium	399,000	(1)	(1)	15,745,000	15,348,000	15,042,000
Bulgaria	2,764,000	(1)	(1)	48,295,000	45,000,000	45,000,000
Denmark	[2] 100,000	(1)	(1)	4,466,000	3,604,000	4,463,000
Finland	(1)	(1)	(1)	125,000	130,000	130,000
France	15,897,000	16,238,000	16,169,000	315,126,000	336,284,000	321,571,000
Germany	4,878,000	4,739,000	4,878,000	149,411,000	160,224,000	171,075,000
Greece	(1)	(1)	(1)	8,009,000	7,000,000	7,000,000
Italy	11,741,000	11,751,000	11,842,000	192,395,000	165,720,000	214,405,000
Montenegro	(1)	(1)	(1)	200,000	200,000	200,000
Netherlands	142,000	143,000	140,000	5,511,000	5,604,000	4,773,000
Norway	[2] 12,000	(1)	(1)	271,000	332,000	300,000
Portugal	1,211,000	(1)	(1)	11,850,000	7,500,000	5,500,000
Roumania	4,769,000	5,114,000	4,011,000	93,724,000	88,924,000	83,236,000
Russia:						
Russia proper	52,557,000	....	....	346,372,000	....	....
Poland	1,255,000	....	....	24,129,000	....	....
Northern Caucasia	9,908,000	....	....	76,537,000	....	....
Total Russia (European)	63,720,000	[3] 71,302,000	[3] 74,512,000	447,038,000	[3] 805,255,000	[3] 962,587,000
Servia	955,000	956,000	(1)	15,312,000	16,351,000	11,000,000
Spain	9,706,000	9,625,000	9,414,000	148,495,000	109,783,000	110,097,000
Sweden	251,000	(1)	(1)	7,945,000	7,832,000	7,800,000
Switzerland	(1)	(1)	(1)	3,524,000	3,178,000	3,500,000
Turkey (European)	(1)	(1)	(1)	20,000,000	18,000,000	18,000,000
United Kingdom:						
England	1,804,000	1,822,000	1,664,000	60,729,000	54,004,000	53,731,000
Wales	38,000	41,000	38,000	1,118,000	1,123,000	1,075,000
Scotland	64,000	62,000	60,000	2,786,000	2,471,000	2,335,000
Ireland	45,000	45,000	34,000	1,656,000	1,564,000	1,295,000
Total United Kingdom	1,951,000	1,970,000	1,796,000	66,289,000	59,162,000	58,436,000
Total	....	....	....	1,805,605,000	2,112,778,000	2,273,483,000
ASIA.						
British India, including such native states as report	30,565,000	31,141,000	29,569,000	375,629,000	370,515,000	358,388,000
Cyprus	(1)	(1)	(1)	2,394,000	2,071,000	2,100,000
Japanese Empire:						
Japan	1,223,000	1,216,000	1,226,000	25,645,000	26,514,000	27,000,000
Formosa	13,400	(1)	(1)	138,000	140,000	140,000
Total Japanese Empire	....	....	....	25,783,000	26,654,000	27,140,000
Persia	(1)	(1)	(1)	16,000,000	16,000,000	16,000,000
Russia:						
Central Asia (4 governments of)	3,616,000	....	....	52,557,000	....	....
Siberia (4 governments of)	5,888,000	....	....	1,255,000	....	....
Transcaucasia (1 government of)	11,000	....	....	9,908,000	....	....
Total Russia (Asiatic)	9,515,000	(4)	(4)	63,720,000	(4)	(4)
Turkey (Asia Minor only)	(1)	(1)	(1)	35,000,000	35,000,000	35,000,000
Total	....	....	....	518,526,000	450,240,000	438,628,000

[1] No data.
[2] Census of 1907.
[3] Includes 10 governments of Asiatic Russia.
[4] Included under total Russia (European).

TABLE 19.—*Wheat crop of countries named, 1911–1913*—Continued.

Country.	Area.			Production.		
	1911	1912	1913	1911	1912	1913
AFRICA.	*Acres.*	*Acres.*	*Acres.*	*Bushels.*	*Bushels.*	*Bushels.*
Algeria	3,554,000	3,614,000	3,448,000	35,874,000	27,172,000	36,848,000
Egypt	1,285,000	1,332,000	1,331,000	38,046,000	30,903,000	30,900,000
Tunis	1,401,000	1,263,000	1,235,000	8,635,000	4,225,000	5,500,000
Union of South Africa	(1)	(1)	(1)	6,034,000	[2] 6,034,000	[2] 6,034,000
Total				88,589,000	68,334,000	79,282,000
AUSTRALASIA.						
Australia:						
Queensland	107,000	43,000	125,000	1,055,000	294,000	2,038,000
New South Wales	2,129,000	2,381,000	2,231,000	28,793,000	25,879,000	33,499,000
Victoria	2,398,000	2,164,000	2,085,000	35,910,000	21,550,000	27,050,000
South Australia	2,105,000	2,191,000	2,080,000	25,112,000	20,994,000	22,174,000
Western Australia	582,000	612,000	793,000	6,083,000	4,496,000	9,457,000
Tasmania	52,000	37,000	25,000	1,156,000	681,000	650,000
Total Australia	7,373,000	7,428,000	7,339,000	98,109,000	73,894,000	94,868,000
New Zealand	322,000	215,000	190,000	8,535,000	8,000,000	5,886,000
Total Australasia	7,695,000	7,643,000	7,529,000	106,644,000	81,894,000	100,754,000
Grand total				3,538,794,000	3,877,087,000	4,125,658,000

[1] No date.

[2] Census figures for the year 1911.

NOTE.—The above figures for European and Asiatic Russia include 72 governments only; the area and production in the whole Empire in 1911 were 80,086,000 acres and 563,485,000 bushels.

New wheat crop Southern Hemisphere.

A cablegram from the International Institute of Agriculture, Rome, Italy, received by the United States Department of Agriculture February 3, contains the following statement of estimated wheat production of the crop of 1913–1914, harvested principally in December and January, of the two principal producing countries of the Southern Hemisphere.

Preliminary estimate of production of all wheat in Australia, 113,344,000 bushels.

Preliminary estimate of total production of all wheat in Argentina and Australia, 244,533,000 bushels.

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